Assessment Schedule – 2020

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

Evidence Statement

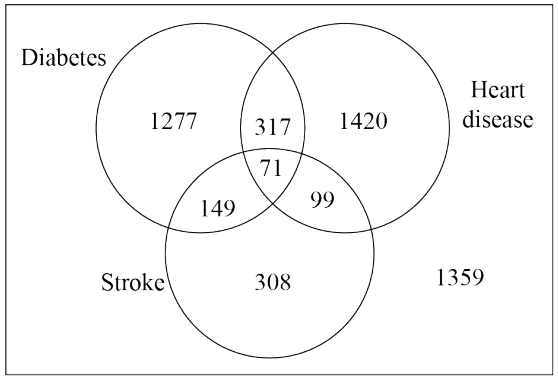
<table>
<tr><th>Q</th><th>Expected Coverage</th><th>Achievement (u)</th><th>Merit (r)</th><th>Excellence (t)</th></tr>
<tr><td>ONE
(a)(i)</td><td>
<table>
<tr><th></th><th>Dehydrated</th><th>Not Dehydrated</th><th>Total</th></tr>
<tr><td>LBS</td><td>20</td><td>12</td><td>32</td></tr>
<tr><td>Normal</td><td>7</td><td>41</td><td>48</td></tr>
<tr><td>Total</td><td>27</td><td>53</td><td>80</td></tr>
</table>
P(dehydrated) = $\frac{27}{80} = 0.3375$
</td><td>P(dehydrated) correctly calculated.</td><td></td><td></td></tr>
<tr><td>(ii)</td><td>P(dehydrated ∩ LBS) = $\frac{20}{80} = 0.25 \neq 0$

As this probability is not equal to zero, the events [‘student is dehydrated’ and ‘student has low blood sugar’] <u>are not</u> mutually exclusive.</td><td>P(dehydrated ∩ LBS) correctly calculated.</td><td>P(dehydrated ∩ LBS) correctly calculated, shown not equal to zero and statement of events not being mutually exclusive.</td><td></td></tr>
<tr><td>(iii)</td><td>Reasons may include:
• Students are selected from only one school – the proportion of low blood sugar after exercise may be different in another school.
• Amount of data – a small number of students (80) have been studied, the estimate of the probability of low blood sugar after exercise may be less accurate for this small group of students.
Accept other valid reasons with clear links to the difference in probability of decreased blood sugar levels.</td><td></td><td>ONE reason identified and explained, with clear link to context.
OR
TWO reasons identified without clear link to context.</td><td>TWO reasons identified and explained, with clear links to context.</td></tr>
</table>

(b)(i)	P(decreased cognitive ability $\cap$ dehydrated and low blood sugar) $= 0.15 \times 0.45 = 0.0675$ P(decreased cognitive ability $\cap$ not dehydrated and normal blood sugar) $= 0.57 \times 0.05 = 0.0285$ P(decreased cognitive ability $\cap$ dehydrated or low blood sugar, but not both) $= 0.28 \times 0.32 = 0.0896$ P(decreased cognitive ability) = 0.0675 + 0.0285 + 0.0896 = 0.1856	At least ONE combined probability correctly calculated.	Probability of decreased cognitive ability correctly calculated.	
(ii)	P(not dehydrated and normal blood sugar | decreased cognitive ability) $= \frac{0.0285}{0.1856} = 0.1536$ The proportion of students with decreased cognitive ability that are neither dehydrated nor have low blood sugar is approximately 15%.		Correct (or consistent) probability with clear working.	Correct (or consistent) probability with clear working. AND Interpretation in context.

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	2 of t

Q	Expected Coverage	Achievement (u)	Merit (r)	Excellence (t)
TWO (a)(i)	P(cholesterol level greater than 200 mg / dL) = (0.05 × 0.73) + (0.95 × 0.24) = 0.0365 + 0.228 = 0.2645 Number expected = 0.2645 × 100 = 26.45. Accept 26 or 27 people.	Number correctly calculated.		
(ii)	P(heart disease | positive test result) $= \frac{\text{P(heart disease} \cap \text{positive)}}{\text{P(positive)}}$ $= \frac{0.0365}{0.2645} = 0.138$ The patient **should not be overly concerned** that they actually have heart disease if they receive a positive test result as the chance of actually having heart disease is **small**.	Conditional probability correctly calculated.	Conditional probability correctly calculated. AND Comment that the patient should not be concerned.	
(iii)	When the threshold value increases, the P(positive test) <u>decreases</u>. The P(**no heart disease** when cholesterol is above the new threshold) decreases significantly compared to P(**heart disease** when cholesterol is above the new threshold). This means that P(heart disease | cholesterol is above the higher threshold) will increase.		Statement that P(positive test) decreases.	Statement that P(positive test) decreases. AND Correct reasoning that P(heart disease | positive test) increases.

(b)(i)	 $\frac{1420}{5000} = 0.284$	Proportion correct.		
(ii)	P (diabetes | heart disease) = $\frac{388}{1907}$ = 0.2035 P (stroke | heart disease) = $\frac{170}{1907}$ = 0.0891 $\frac{\text{P(diabetes} \mid \text{heart disease)}}{\text{P(stroke} \mid \text{heart disease)}} = 2.282$ The **claim is justified**, as a [randomly chosen] patient is **more than twice as likely** to be diagnosed with diabetes compared to stroke (given that they have been diagnosed with heart disease).	At least one conditional probability correctly calculated.	Calculation of correct ratio using **correct** denominator. OR Correct ratio found with use of **incorrect** denominator and claim confirmed with justification.	Calculation of correct ratio. AND Claim confirmed with justification.

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	2 of t

<table>
<tr><th>Q</th><th>Expected Coverage</th><th>Achievement (u)</th><th>Merit (r)</th><th>Excellence (t)</th></tr>
<tr><td>THREE
(a)(i)</td><td>
<table>
<tr><td></td><td>Tanning</td><td>No tanning</td><td>Total</td></tr>
<tr><td>Male</td><td>45</td><td>67</td><td>112</td></tr>
<tr><td>Female</td><td>76</td><td>62</td><td>138</td></tr>
<tr><td></td><td>121</td><td>129</td><td>250</td></tr>
</table>
</td><td>All entries as counts in the table (not percentages nor unrounded counts).</td><td></td><td></td></tr>
<tr><td>(ii)</td><td>$P(\text{tan} \mid \text{female}) = \frac{76}{138} = 0.5507$
$P(\text{tan} \mid \text{male}) = \frac{45}{112} = 0.4018$
Students are more likely to have participated in artificial tanning in the last 12 months if they are female [than if they are male].</td><td>At least one correct (consistent) conditional probability calculated.</td><td>Both (consistent) conditional probabilities calculated.
AND
Correct conclusion.</td><td></td></tr>
<tr><td>(iii)</td><td>$\frac{P(\text{tan} \mid \text{female})}{P(\text{tan} \mid \text{male})} = 1.371$
1.371 times as likely (or 37.1% more likely) for a female to tan [compared to a male].
Data does not support the claim [that females are 1.5 times as likely to tan] as the ratio is less than 1.5.</td><td></td><td>Correct (consistent) ratio calculated.</td><td>Correct (consistent) ratio calculated and interpreted
AND
Consistent statement about the claim.</td></tr>
</table>

(b)(i)	$P(\text{female} \cap \text{ear piercing(s)}) = \frac{91}{250} = 0.364$ $P(\text{female}) \times P(\text{ear piercing(s)}) = \frac{138}{250} \times \frac{149}{250} = 0.329$ As P(female) × P(ear piercing(s)) ≠ P(female ∩ ear piercing(s)), the two events stated are <u>not</u> independent. OR using the conditional probability test, for example, $P(\text{ear piercing(s)}) = \frac{149}{250} = 0.596$ $P(\text{ear piercing(s)} \mid \text{female}) = \frac{91}{138} = 0.659$ Different answers suggest <u>non</u>-independence of the two events stated.	Relevant probabilities calculated for the test chosen.	Relevant probabilities calculated for the test chosen. AND Statement of non-independence of events.	
(ii)	P(3 males have ear piercing(s)) = $\frac{58}{112} \times \frac{57}{111} \times \frac{56}{110} = 0.1354$ P(2 males have ear piercing(s)) = $\left(\frac{58}{112} \times \frac{57}{111} \times \frac{54}{110}\right) + \left(\frac{58}{112} \times \frac{54}{111} \times \frac{57}{110}\right) + \left(\frac{54}{112} \times \frac{58}{111} \times \frac{57}{110}\right)$ $= 0.3916$ P(2 or 3 males have ear piercing(s)) = = 0.1354+ 0.3916 = 0.5270 Assumptions: • Assumption made that the **presence of ear piecing(s)** for each male is **independent**. • Assumption made that **sampling without replacement** is necessary as you can't **reselect** a male.	Probability **correctly** calculated for **either** 2 or 3 males having ear piercing(s). OR **Incorrect** probability calculated for **either** of 2 or 3 males having ear piercing(s) using sampling with replacement. That is, P(3 males have ear piercing(s)) = 0.1389 P(2 males have ear piercing(s)) = 0.3879	Probability **correctly** calculated for **sum** of 2 or 3 males having ear piercing(s). OR **Incorrect** probability calculated for **sum** of 2 or 3 males having ear piercing(s) using sampling with replacement. That is, P(2 or 3 males have ear piercing(s)) = 0.1389 + 0.3879 = 0.5268	Probability **correctly** calculated for 2 or 3 males having ear piercing(s). AND One assumption stated clearly in context.

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Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 14	15 – 19	20 – 24