Assessment Schedule – 2024

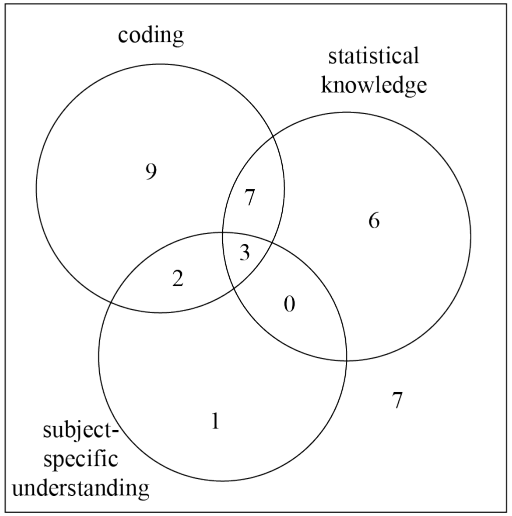
Mathematics and Statistics (Statistics): Apply probability concepts in solving problems (91585)

Evidence Statement

Q	Expected Coverage	Achievement (u)	Achievement with Merit (r)	Achievement with Excellence (t)
ONE (a)(i)	P(AI indicated) = (0.78 × 0.01) + (0.22 × 0.26) = 0.065. Number of pieces = 0.065 × 120 = 7.8 = 8 pieces	• Correct number of pieces of work.		
(ii)	P(human | AI indicated) $= \frac{0.78 \times 0.01}{0.065} = 0.12$ For those pieces of work that are indicated as being AI generated, 12% are produced by a human. This is a significant proportion (around 1 in 8), therefore the teacher **should** be concerned that a student could be unfairly accused of plagiarism.	• Correct conditional probability.	• Correct conditional probability AND Comment that teacher should be concerned (with justification).	
(b)(i)	P(time < 25% | cheat) = 0.8. P(time < 25%) = 0.2 If independent, P(time < 25% | cheat) should equal P(time < 25%) but P(time < 25% | cheat) ≠ P(time < 25%) Because these probabilities are not the same, these two events are not independent of each other. *Accept other valid methods of proving independence.* *Eg, P(time<25%) = 0.2; P(cheats)=0.01; P(cheats ∩ time<25%) = 0.008* *P(time<25%) × P(cheats)= 0.2 × 0.1 = 0.002* *As P(cheats ∩ time<25%) ≠ P(time<25%) × P(cheats) the events are not independent.* --- If students are cheating, it is **more likely** [about four times as likely] for them to complete the assessment in less than 25% of the allocated time, compared to students who are not cheating.	• Correct probabilities calculated/stated as part of a reasonable attempt to use an independence argument. OR • Correctly calculated ONE probability towards their independence calculation (eg. 0.002 or 0.008 or other appropriate calculation)	• Full and correct explanation that shows complete understanding of non-independence in context.	• Merit AND Clear explanation of the **relationship** between the two events.
(ii)	P(Cheat) = 0.01 P(Complete in less than 25% of the allocated time) = 0.2 P(Complete in less than 25% of the allocated time | Cheat) = 0.8 P(Cheat and complete in less than 25% of the allocated time) = 0.8 × 0.01	• Correct probability.		

	= 0.008 *Accept alternative methods.*			
(iii)	Reasons why care should be taken, for example: • Data given is only for NCEA students sitting this particular external assessment. Predictions made based on this data may not be correct, as these students may have different cheating behaviours than others. The estimate of the proportion of students who cheat and complete the assessment quickly could be more or less for students sitting other exams. • Data given is collected from one school. Predictions made based on this data may not be correct, as students from different schools may be more or less likely to cheat. The estimate of the proportion of students who cheat and complete the assessment quickly could be more or less for students from other schools. • Some cheating may go undetected as it can be difficult to find out whether a student cheated or not. This means the cheating rate may actually be higher as some students are not caught.	• ONE reason identified in context without sufficient detail.	• ONE reason identified and clearly explained in context.	TWO reasons identified and clearly explained in context.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempts at least 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)	Achievement with Merit (r)	Achievement with Excellence (t)
TWO (a)(i)	 Number selected for shortlist = 3	• Correct count of number of candidates selected for shortlist. OR Correct proportion of candidates selected for shortlist.		
(ii)	P(only one of three skills) = $\frac{16}{35}$ or 0.457	• Correct probability.	• At least 5 correct values in Venn diagram (or other correct appropriate representation) AND correct probability.	
(iii)	P(coding skills | math & stat knowledge) = $\frac{10}{16} = 0.625$ P(subject-specific understanding | math & stat knowledge) = $\frac{3}{16} = 0.1875$ $\frac{0.675}{0.1875} = 3.333 \implies$ It is over 3 times as likely to see coding skills than subject-specific understanding for those applicants that have the required mathematical and statistical knowledge. OR $\frac{0.1875}{0.675} = 0.3 \implies$ It is 0.3 times as likely to see subject-specific understanding than coding skills for those applicants that have the required mathematical and statistical knowledge. Data **does not support the claim** as applicants are less likely to have subject specific understanding than coding skills.	• One correct probability calculated.	• Both probabilities calculated and relative calculation.	• Relative calculation explained with a statement that the data does not support the claim. .

(b)(i)	Proportion of students gaining NCEA Level 2 or above in 2012 is 77.3% Proportion of students gaining NCEA Level 2 or above in 2022 is 82.4% The claim that the total proportion of 18-year-olds that have NCEA Level 2 or above has increased from 2012 to 2022 **is** supported by the data. However, the data peaks in 2018 at 85.1% indicating that the change in proportion of students who have NCEA Level 2 or above is not consistent from year to year. Optional comparisons include: *2022 vs 2012* $\frac{82.4}{77.3} = 1.066 \Rightarrow$ Students are 1.066 times as likely [6.6% more likely] to have NCEA Level 2 or above in 2022 vs 2012. *2022 vs 2021* $\frac{82.4}{83.7} = 0.984 \Rightarrow$ Students are 0.984 times as likely [1.6% less likely] to have NCEA Level 2 or above in 2022 vs 2021.	• Comparison of proportions for 2012 and 2022. AND Conclusion that the claim of an increase in proportion that have NCEA Level 2 or above is supported by the data.	• As for Achievement. AND Additional calculation (or recognition of a peak in 2018 at 85.1%) showing that the change is not consistently positive from year to year.	
(ii)	The relative proportion of 18-year-old students gaining their NCEA Level 2 or above from post-school education has decreased over the period 2012 to 2022. In 2012, 6.1% out of 77.3% (0.07891) of students gained their qualification post-school. In 2022, 4.1% out of 82.4% (0.04976) of students gained their qualification post-school. This is a relative proportion of $\frac{0.04976}{0.07891} = 0.6305$. Of 18-year-olds with NCEA L2, this is a 37% decrease from 2012 to 2022 in the proportion gaining post-school qualifications. 18-year-olds are much less likely to gain their Level 2 or above NCEA qualification post-school in 2022 compared to 2012.	• At least one correct proportion calculated. OR Compares 6.1% and 4.1% and states that 18-year-old students gaining their NCEA Level 2 or above from post-school education has **decreased** over the period 2012 to 2022.	• Calculation of relative change. OR Both proportions calculated.	• Comment, with comparison of proportions or using the relative proportion, that 18-year-olds are **less likely** to gain their qualification post-school in 2022 compared to 2012.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempts at least 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)	Achievement with Merit (r)	Achievement with Excellence (t)
THREE (a)(i)	P(win on one occasion) = P(score is between 5 and 10 inclusive) $= \frac{27}{36} = \frac{3}{4}$ P(wins at least once from three games) = 1– P(loses all three times) $= 1 - \left(\frac{9}{36}\right)^3$ = 1 – 0.015625 = 0.984375	• Correct probability of winning one game.	• Correct probability of winning at least once.	
(ii)	P(lost before the third roll) = P(lost in first roll) + P(lost in second roll) $= \frac{6}{36} + \left(\frac{24}{36} \times \frac{6}{36}\right)$ $= \frac{5}{18}$ or 0.2778	• Correct probability for losing in either first or second roll.	• Correct probability of losing before the third roll.	

(b)(i)	<table><tr><td>Outcome</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>**Totals**</td><td>138</td><td>189</td><td>197</td><td>143</td><td>179</td><td>154</td></tr><tr><td>**Relative frequency**</td><td>0.138</td><td>0.189</td><td>0.197</td><td>0.143</td><td>0.179</td><td>0.154</td></tr></table>P(3 or less) = 0.524 P(4 or more) = 0.476 Rolling a 3 or less **is more likely** than rolling a 4 or more.	• Correct conclusion supported by at least one correct probability.		
(ii)	The true probability of each outcome for this die is unknown. The simulation results are an experimental distribution which allows us to see the variation in the numbers / proportion of each outcome from rolling the die for sample size 1000, using a theoretical / model probability of each outcome of $\frac{1}{6} = 0.167$. We can compare the observed counts / proportions (experimental probabilities of each outcome) to this simulated distribution to consider the likelihood of the observed result happening. Based on the model, we would expect a 1 to occur with a probability of 0.167. The observed probability of a 1 for this die is 0.138. Even taking sampling variability into account, we very rarely see as few '1's in the simulated results, as were observed. The player should be concerned that their die may be biased.	• Indication that the experimental probabilities vary from the theoretical probability.	• Discussion of how the simulation results allow us to compare what was observed with what is expected based on the theoretical / model probabilities.	• A clear discussion of how the simulation results allow us to take into account sampling variation to make a decision on whether the die is biased, including clear explanation of experimental, theoretical and true probability in this context, and reference to the sample size.
(iii)	If this die is biased, and fewer '1's are occurring than expected, then the probability of rolling a total of 2 will be reduced. This means that it is less likely to roll a total of 2 and lose.			• A clear explanation of the effect of using the biased die on the reduction of the probability of rolling a total of 2.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempts at least 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

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24