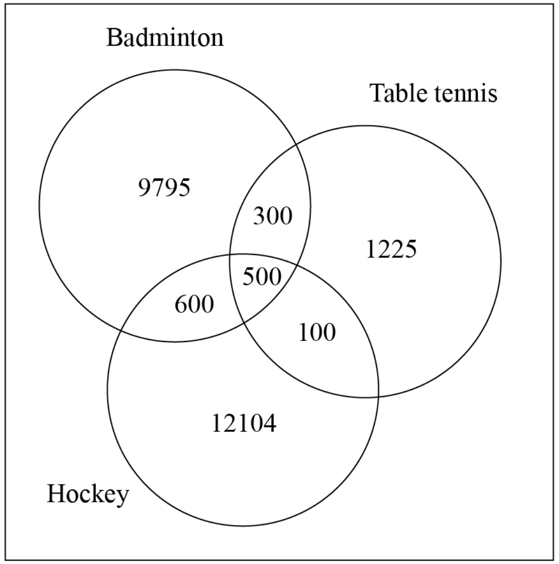
Assessment Schedule – 2025

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)	 $P(\text{Only one sport}) = \frac{23\,124}{144\,862} = 0.1596$	• Venn diagram or other diagram organiser correctly displaying the data. OR Correct probability.		
(b)	$P(\text{Hockey} \cap \text{Table tennis} \cap \text{Not badminton})$ $= \frac{100}{13\,304} = 0.0075$		• Correct answer.	

(c)	$P(\text{Badminton} \cap \text{Hockey}) = \frac{1100}{144\ 862} = 0.0076$ $P(\text{Badminton}) \times P(\text{Hockey}) = \frac{11195}{144\ 862} \times \frac{13\ 304}{144\ 862} = 0.0071$ Alternative answer: $P(\text{Badminton} \mid \text{Hockey}) = \frac{1\ 100}{13\ 304} = 0.083$ $P(\text{Badminton}) = \frac{11\ 195}{144\ 862} = 0.0773$ As the joint probability of playing badminton and hockey is not equal to the expected probability, the two events are not independent. Students who play hockey are less likely to play badminton, compared to the general student population.	• One probability correct. (Either $P(B \cap H)$ or $P(B) \times P(H)$)	• Compares joint probability with the expected probability to make conclusion of lack of independence. OR Compares conditional probability with marginal probability to make conclusion.	• Clear, contextual description of the relationship between the two events.

(d)(i)	$P(\text{injury}) = 0.8 \times 0.04 + 0.2 \times 0.1 = 0.052$ $P(\text{artificial turf} \mid \text{injury}) = \dfrac{0.032}{0.052} = 0.6154$	• Correctly calculates P(injury).	• Correct conditional probability.	
(ii)	Care should be taken with generalising this data to all football players in general, because this data is only collected from one school, during one season, from student football players. Older football players may be more (or less) likely to be injured on different surfaces than younger football players, Injury rates may vary depending on the level of the football players, Injury rates may vary depending on season / weather conditions, Injury rates may differ depending on location e.g. different types of turf or natural grass surfaces.	• States one relevant issue.	• Discusses impact of one relevant issue on injury rates.	• Discusses impact of TWO relevant issue on injury rates.
(iii)	$P(X = 1) = 3 \times 0.052 \times 0.948 \times 0.948$ $= 0.1402$ Assumptions: • The injury rate is the same for each student. We don't know on what surface the students played - some students may have played on artificial turf and others on grass, which have different injury risks. Because the surface type is unknown, we assume an equal rate for all. Injuries are independent between students. In reality, injuries might not be fully independent (e.g., slippery conditions could increase the injury risk for everyone). If injuries were not independent, we would underestimate or overestimate the actual probability of one student being injured.	• Calculation of $P(X = 1)$. Allow 0.0467.	• Correct calculation of $P(X = 1) = 0.1402$. OR At least one assumption, in context.	• Correct calculation of $P(X = 1) = 0.1402$. AND At least one assumption, 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)	$(\text{Netball} \mid \text{Basketball}) = \dfrac{P(\text{Both netball and basketball})}{P(\text{Basketball})} = \dfrac{6\,000}{26\,572} = 0.2258$ The number of students playing both sports has been estimated, rather than counted. If this number is too high, then this probability will be an overestimate (and vice versa).	• Correct probability. AND Explanation that this is only an estimate.		
(b)	Some students play both netball and basketball (the 2023 census estimates 6000 students playing both). $P(\text{Netball} \cap \text{Basketball}) = \dfrac{6\,000}{144\,862} = 0.0414$ Since $P(\text{Netball} \cap \text{Basketball}) > 0$, the events are not mutually exclusive.	• Identifies that $P(N \cap B) > 0$ or that 6000 play both.	• Identifies probabilities of $P(N \cap P) > 0$ linked to context.	
(c)(i)	$P(C \cup T+) = 0.205 + 0.198 - 0.074 = 0.329$	• Correct probability.		
(ii)	P(Did not have concussion) = 0.124 + 0.671 = 0.795 79.5% of players did not have a concussion after a head knock, which supports the claim that most head knocks in school rugby do not result in concussion.	• Correct probability.	• Correct conditional probability and correct interpretation of NZ Rugby Union's claim.	• Provides a clear interpretation in context, explaining why the data does not support the coach's claim that the test strongly indicates a concussion.
(iii)	P(Concussion and Positive Test) = 0.074 P(Positive Test) =0.074 + 0.124 = 0.198 $\text{P(Concussion} \mid \text{Positive Test)} = \dfrac{0.074}{0.198} \approx 0.374$ There is a 37.4% chance that a player with a positive sideline test actually has a concussion, and this is greater than "one in four", i.e. 25%. The coach's statement is not supported by the data.			

(d)	True probablility from 2023 census data $= \dfrac{8\,880}{50\,000} = 0.1776$ Model probability based on historial percentage $= 0.25$ Experimental probability from random sample in 2023 $= \dfrac{120}{1000} = 0.12$ The true probability is based on the entire census, and is likely to be the most accurate. The model estimate is based on the opinion of sports coordinators, which isn't realistic. The experimental estimate may be unreliable because it is based on a small sample size.	• Correctly calculates the probabilities for each method (True, Model, and Experimental).	• Compares all three probabilities.	• Compares all three probabilities. AND Conclusion that true probability is most accurate, justified 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)
THREE (a)(i)	2005: $P(\text{Ultimate Frisbee}) = \frac{150}{1100} = 0.1364$ 2010: $P(\text{Ultimate Frisbee}) = \frac{400}{15100} = 0.2667$ 2015: $P(\text{Ultimate Frisbee}) = \frac{800}{2150} = 0.3721$ 2020: $P(\text{Ultimate Frisbee}) = \frac{1250}{2450} = 0.5102$ 2020 has the highest participation.	• Correct year identified with comparison of at least two probabilities. OR Justification that the number of ultimate frisbee participants exceeds the number of archery participants, only in 2020.		
(ii)	Possible responses: The given probabilities only compare participation in ultimate frisbee and archery. They ignore students who participated in other sports, or those who did not play any sport. If overall student sports participation increased, the proportion of students playing ultimate frisbee may not have changed significantly, even if raw numbers increased. If the number of students in other sports also grew, ultimate frisbees' true proportion among all sports could be lower than the calculated values. The data might not represent all schools or regions, leading to bias. Changes in data collection methods over time, such as more accurate counting or the inclusion of more schools, could affect comparisons. The probabilities are useful for comparing ultimate frisbee relative to archery, but not for evaluating ultimate frisbees popularity overall. A more accurate measure would require total school sports participation data.	• Identifies one reason not representative.	• Identifies one reason not representative. AND Discusses ONE reason for increase in context.	• Identifies one reason not representative. AND Discusses TWO reasons for increase in context.
(b)(i)	$P(X \geq 4) = 0.45$	• Correct probability.		
(ii)	$\frac{P(X < 4)}{P(X \geq 4)} = \frac{0.55}{0.45} = 1.22$ The claim is not supported because 1.22 is less than 2.		• Justified conclusion that the claim is not supported.	

(c)(i) (ii)	In addition to a low rate of classifying the players based on ability: Only $\frac{42}{50} = 0.84$ of players of ability at the required standard were selected. And $\frac{13}{25} = 0.52$ of players of below-standard ability were selected for the squad. Proportion ofccorrect classifications $= \frac{42+13}{75} = \frac{55}{75} = 0.7333$. $P(\text{at standard} \mid \text{selected}) = \frac{42}{50} = 0.778$ $P(\text{not at standard} \mid \text{selected}) = \frac{12}{54} = 0.222$ $P(\text{selected} \mid \text{not at standard}) = \frac{12}{25} = 0.48$ The observer does not meet the coach's goal of 90% accuracy, as 73% (or other probabilities correctly compared) is less than 90%, due to a high rate of selecting players of below-standard ability for the squad.	• Correct probability.	• At least one proportion used appropriately to support reasoning about a potential issue with the observer's selections.	• States that the model has a high rate of selection of below-standard players AND compares with coach's goal..

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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 – 13	14 – 18	19 – 24