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NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Mathematics and Statistics (Statistics) 2025

91585 Apply probability concepts in solving problems

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply probability concepts in solving problems.	Apply probability concepts, using relational thinking, in solving problems.	Apply probability concepts, using extended abstract thinking, in solving problems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Make sure that you have the Formulae and Tables Booklet L3–STATF.

Show ALL working.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in in the margins (⁄⁄⁄). This area will be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

School Sport New Zealand organises and promotes secondary school sports tournaments. Since 2000, they have collected annual data on student participation by sport, region, and gender. The most recent 2023 School Sports Census covered 91 different sports, and surveyed a total of 144 862 students representing their school in at least one sport.

QUESTION ONE

The 2023 School Sports Census showed:

- badminton: 11 195 participants
- table tennis: 2125 participants
- hockey: 13 304 participants

Follow-up surveys in some regions have been used to estimate the numbers of students who participated in the following combinations of sports:

- badminton and table tennis: 800
- table tennis and hockey: 600
- badminton and hockey: 1100
- badminton, table tennis, and hockey: 500

(a) Estimate the probability that a randomly selected student from the 2023 School Sports Census participates in only one of these three sports (badminton, table tennis, and hockey).

(b) A student is randomly selected from those who play hockey.

Estimate the probability that they play both hockey and table tennis, but not badminton.

(c) Interpret the relationship between the events ‘student plays badminton’ and ‘student plays hockey’. As part of your answer, explain whether these two events are independent.

Use calculations and statistical reasoning to support your answer.

(d) A school is comparing the risk of football injuries on two different playing surfaces: artificial turf and natural grass. Over a season, data from football matches played at this school showed:

- 80% of the games were played on artificial turf.
- The rest of the games were played on natural grass.
- On artificial turf, the probability of a player getting injured in a game was 0.04.
- On natural grass, the probability of injury was 0.10.

(i) Given that a player was injured, calculate the probability that the game was played on artificial turf.

(ii) The school claims that, in general, for students playing football, more injuries occur playing on artificial turf than on natural grass.

Discuss why care should be taken using this data to make this claim.

(iii) Estimate the probability that, from a group of three randomly selected football players at this school, only one is injured during their game.

State and justify any assumption(s) that you have made in calculating this probability.

QUESTION TWO

In the 2023 School Sports Census:

- Netball had 26 950 registered participants.
- Basketball had 26 572 registered participants.
- Among all the students, it was estimated that 6000 played BOTH netball and basketball.

(a) If a student is selected at random, and is known to play basketball, what is the probability they play netball?

Give ONE reason why this answer can only be an approximation.

(b) Explain whether the events ‘student plays netball’ and ‘student plays basketball’ are mutually exclusive.

(c) Concussion is a common concern in school sports, especially after head knocks in contact sports. Concussion assessment tests conducted on the sideline give either a positive or negative result for potential concussion, but they are not always accurate.

A study was conducted with 298 secondary school rugby players who experienced a head knock during games. After the sideline test was used, a medical assessment was done to confirm whether each player actually had a concussion or not. Data from this study is shown in the table below.

	Had a concussion	**Did not have a concussion**
Positive sideline test	0.074	0.124
Negative sideline test	0.131	0.671

(i) Calculate the probability that a randomly chosen rugby player had a concussion or had a positive sideline test.

(ii) A safety guideline states that "... most head knocks in school rugby do not result in concussion."

Does the data from this study support this claim?

(iii) A coach says: "If a player gets a positive sideline test result, there's a 'one in four' chance they actually have a concussion."

Does the data from this study support this claim?

Support your answer with statistical reasoning.

(d) The 2023 School Sports Census of 50 000 students recorded 8880 cricket players. A random sample of 1000 New Zealand secondary school students found that 120 played cricket. Amongst secondary school sports coordinators in New Zealand, it is thought that about 25% of students played cricket.

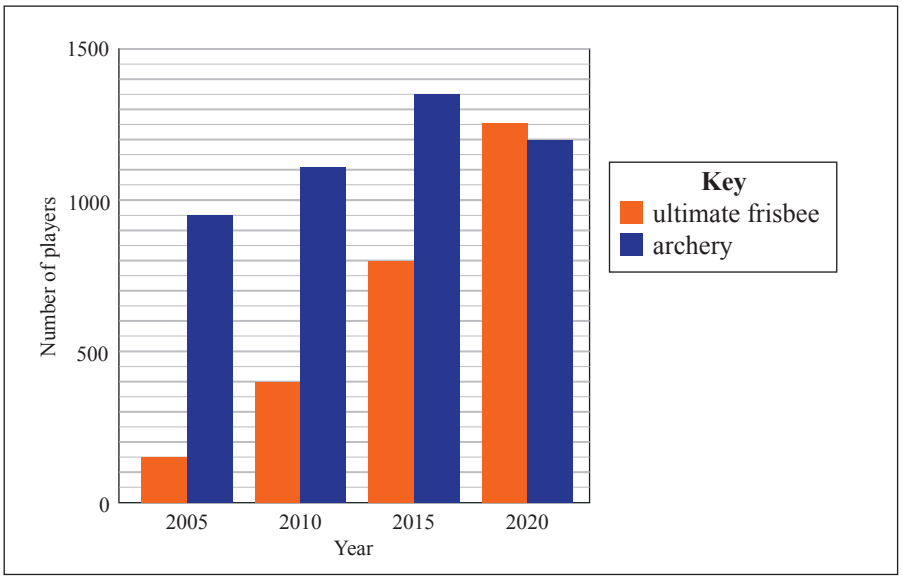
Compare the **true probability**, **model estimate**, and **experimental estimate** for cricket participation in 2023.

Discuss which estimate is the most reliable for predicting future cricket participation.

Use statistical reasoning to support your answer.

QUESTION THREE

(a) The School Sports Census data for ultimate frisbee and archery from 2005 to 2020 is summarised below.



(i) In which year did ultimate frisbee have the highest proportion of the total participants in these two sports?

Justify your answer by referring to the graph.

(ii) Explain why the probabilities calculated from this data might not correctly represent the probability of a student playing ultimate frisbee, compared to other sports, in those years.

(b) A sports coordinator is using data from their school to model how long it takes students to decide which sport to play after trying out for rugby and futsal. They are considering using an intervention to reduce the number of students taking a very long time to decide which sport to play. Students who take 4 or more weeks to decide will receive the intervention.

The table below shows the probability distribution of the random variable, X, the number of weeks a student takes to decide which sport to play.

X (weeks)	0	1	2	3	4	5	6	7 or more
$P(X = x)$	0.05	0.12	0.18	0.20	0.15	0.10	n	0.15

(i) Estimate the proportion of students who will require the intervention.

(ii) It is claimed that twice as many students take less than 4 weeks to decide which sport to play, compared to taking 4 or more weeks to decide.

Does the data support the claim?

Question Three continues on the following page.

(c) A school sports coach uses observers to classify players from tryouts as ‘selected’ for the squad, or ‘not selected’. Students who perform at the required standard should be selected, and those who perform below the required standard should not be selected. The coach has a goal of 90% accuracy of selecting the correct players based on their ability.

75 students attended the tryouts. An observer correctly selected 42 out of 50 players who performed at the required standard, but also selected 12 players from the 25 students who performed below the required standard. The results of the tryouts are summarised in the table below.

		Performance	
		At standard	**Below standard**
Tryout result	**Selected**	42	12
	Not Selected	8	13

(i) Calculate the proportion of students who received the correct result of ‘selected’ or ‘not selected’, based on their performance.

(ii) Comment on the effectiveness of the observer in selecting the correct players for the netball squad.

Support your answer with at least one calculation.

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Write the question number(s) if applicable.

QUESTION NUMBER

Extra space if required.
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QUESTION NUMBER