

SUPERVISOR'S USE ONLY

**2**Draw a cross through the box (☒)  
if you have NOT written in this booklet

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**91267**

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**Mana Tohu Mātauranga o Aotearoa**  
New Zealand Qualifications Authority

## Level 2 Mathematics and Statistics 2023

### 91267 Apply probability methods in solving problems

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply probability methods in solving problems.	Apply probability methods, using relational thinking, in solving problems.	Apply probability methods, 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.**

Show ALL working.

Make sure that you have the Formulae Sheet L2–MATHF.

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 2–15 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE). 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.**

**QUESTION ONE**

Alex likes playing the claw game at the arcade.

She finds out that the machines are programmed and are not based on the skill of the user.

A particular claw game that Alex plays has these settings:

- In 15% of games, the claw picks up a toy, but ‘drops’ it again.
- Out of the other attempts, about 1 in 10 games will be selected to be won by the machine generating a random number. This means the probability the first game is won is  $1/10$ .
- If a game is not won, then the probability of the subsequent games will change as the remaining random numbers decrease, i.e. the probability of the second game being won is  $1/9$ , and so on.



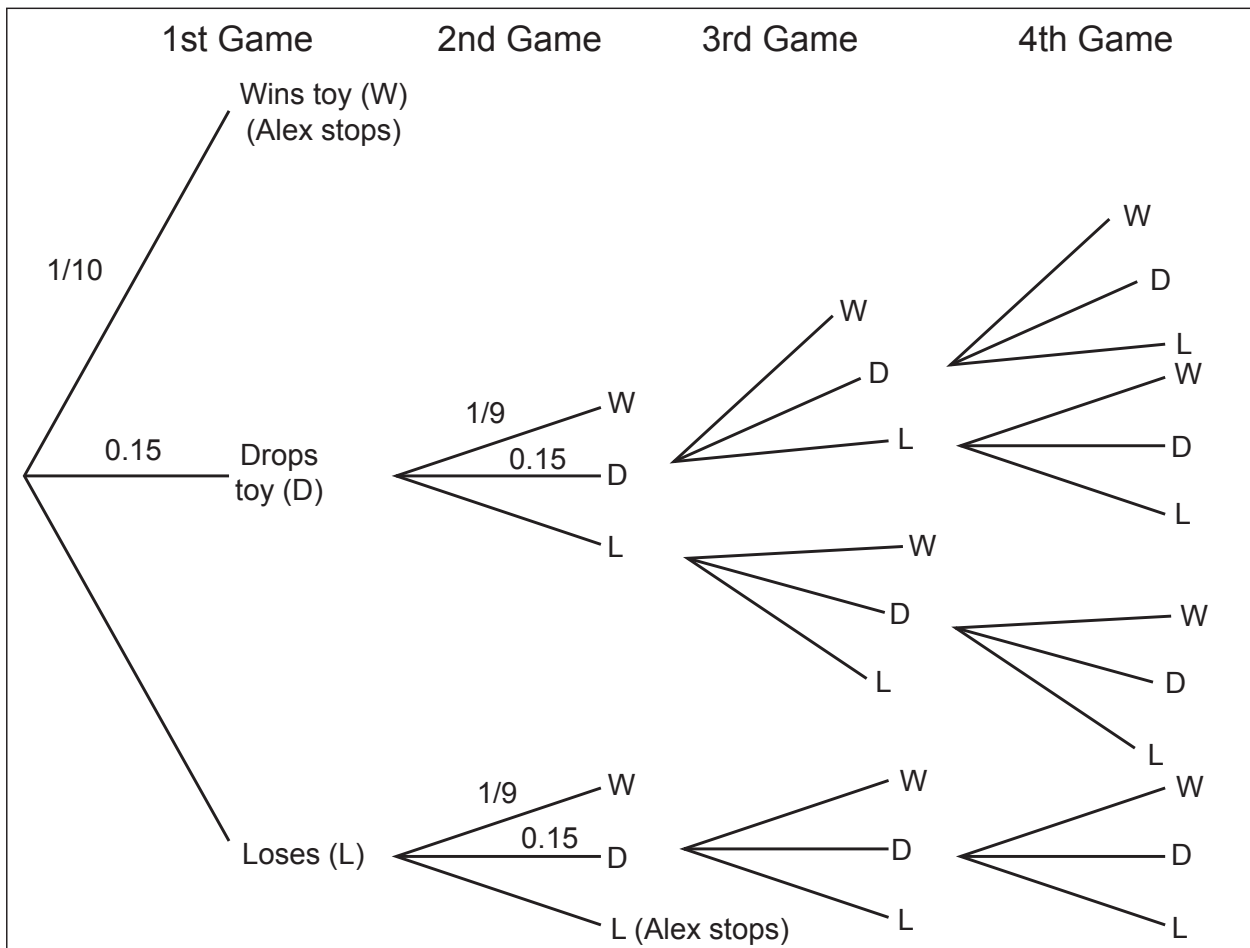
Source: [www.istockphoto.com/photo/claw-vending-machine-gm497990062-79428151](https://www.istockphoto.com/photo/claw-vending-machine-gm497990062-79428151)

One day Alex watches someone else win a toy, and then she plays the claw game with this strategy:

- If she wins a toy, she stops.
- If the claw ‘drops’ the toy, she always tries again.
- She keeps playing until she has had two losses (without it dropping) or a maximum of 4 games in total.

(a) Complete the tree below and use it to answer the questions on the next page.

**Figure 1**



- (i) What is the probability that the claw ‘drops’ on the first game, and Alex wins the second game she plays?

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- (ii) What is the probability that Alex wins the third game she plays?

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- (iii) What is the probability that Alex wins the claw game within a maximum of 4 attempts?

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(b) When Alex goes to the arcade, 70% of the time she goes with her friends.

If she goes with her friends, she plays the ‘claw’ just once, and wins on 10% of these visits.

If she is by herself, she plays multiple games and wins on about  $\frac{1}{4}$  of these visits.

Space for probability tree



## QUESTION TWO

A survey of New Zealand media usage is completed regularly by NZ on Air.

- (a) The following results were reported from the 2021 survey.
- 1420 participants were asked if they had watched each of the media types the day before for at least 5 minutes.
  - The data was split between New Zealand youth (aged 15–24) and New Zealanders aged 25 years and older.

**Table 1: Media usages of New Zealand youth (15–24) and adults (25+) in 2021**

Media type		NZ Youth 15–24	NZ adults 25+	Total
Online video	Y	228	610	838
	N	23	559	582
	Total	251	1169	1420
Streaming services	Y	191	533	724
	N	60	636	696
	Total	251	1169	1420
TV	Y	90	705	795
	N	161	464	625
	Total	251	1169	1420

Source: [www.nzonair.govt.nz/research](http://www.nzonair.govt.nz/research)

- (i) Find the probability that a randomly chosen survey participant is a New Zealand youth who watched a streaming service the day before.

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- (ii) Tao looks at the table above, and says that “more adults (25+) watch online videos than youth (15–24), so this means adults in New Zealand are more likely to watch online videos than youth.”

Is he correct?

Justify your answer using calculations to support your reasoning.

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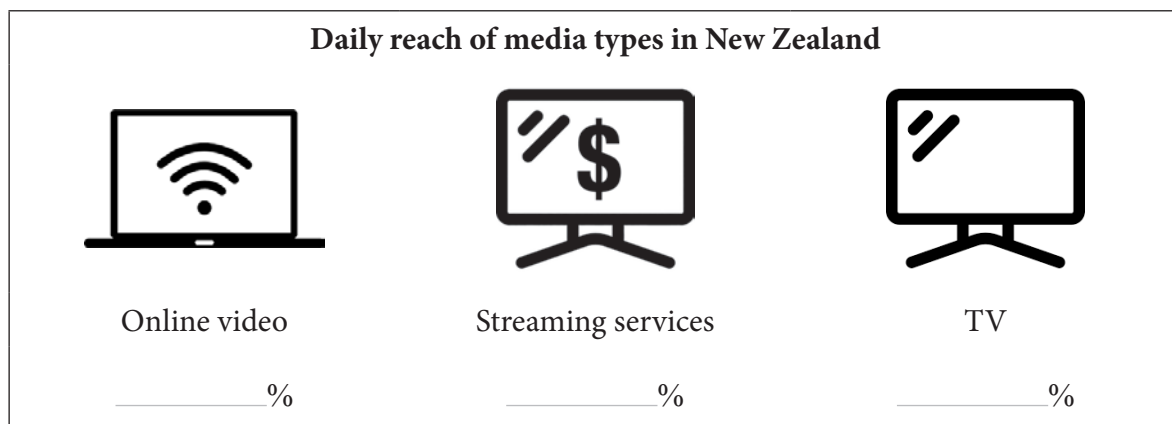
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- (iii) The report wants to include an infographic showing the “daily reach” (percent usage) of various types of media.

Find the overall percentage of New Zealanders using each of the three media types given, according to the survey results.



- (iv) The report claims that “New Zealand youth are about 70% more likely to watch streaming services, but over 40% less likely to watch TV, than New Zealanders aged 25 and over”.

Evaluate this claim using appropriate calculations.

- (b) The results of four similar surveys about media usage conducted in different years are shown below.

**Table 2: New Zealand youth (aged 15–24) watching streaming services daily**

		2016		2020	2021	2022
<b>Watch streaming services daily</b>	<b>Y</b>	102		181	191	473
	<b>N</b>	147		81	60	233
	<b>Total</b>	249		262	251	706

- (i) How much higher is the percentage of New Zealand youth who watch streaming services in 2022 than it was in 2016?

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- (ii) If 400 youth were surveyed in 2023, approximately how many would you expect to watch streaming services?

Justify your answer based on at least one calculation from the table above.

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### QUESTION THREE

A recent study reported that New Zealand youth (aged 15–24) spend an average (mean) of 113 minutes per day watching **streaming services**.

- (a) Assume the distribution of minutes watching streaming services per day follows a normal distribution, with a standard deviation of 35 minutes per day.
- (i) Find the probability that a randomly selected New Zealand youth spends under 92 minutes a day watching **streaming services**.

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- (ii) Find the probability that a New Zealand youth spends between two and three hours watching **streaming services** daily.

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- (b) In the same study, New Zealand youth were reported to watch **online videos** for 94 minutes daily on average, with a standard deviation of 30 minutes.
- (i) Find the interquartile range (middle 50%) for the number of minutes that New Zealand youth reportedly spend watching **online videos**.

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- (ii) Out of a group of 50 New Zealand youth, how many more respondents would you expect to have spent over 2 hours (120 minutes) watching **streaming services** than **online videos**?

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- (iii) Give at least TWO reasons why a normal distribution may not be appropriate in these contexts of the number of minutes spent watching **streaming services** and **online videos** for all New Zealand youth.

You may want to include a sketch of what you expect the real distribution of one of these contexts would look like, to support your answer.

Reason 1: \_\_\_\_\_

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Reason 2: \_\_\_\_\_

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- (c) In the study, it was also reported that overall, New Zealand youth watched a daily average of only 34 minutes of **TV**. However, when excluding those who didn't watch **TV** at all, the average was 114 minutes daily.

- (i) Explain the effect of including the youth who did not watch **TV** at all, on the mean and distribution of minutes of watching **TV** by New Zealand youth.

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Question Three  
continues on the  
following page.

- (ii) Assume a normal distribution models the number of minutes New Zealand youth spend watching TV daily with a mean of 114 minutes (excluding non-TV watchers).

If 12% of New Zealand youth who do watch TV, watch more than 150 minutes daily, calculate the standard deviation of daily minutes spent watching TV.

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