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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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SUPERVISOR'S USE ONLY

Level 3 Mathematics and Statistics (Statistics), 2013

91585 Apply probability concepts in solving problems

9.30 am Wednesday 20 November 2013
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.

Show ALL working.

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

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–10 in the correct order and that none of these pages is blank.

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

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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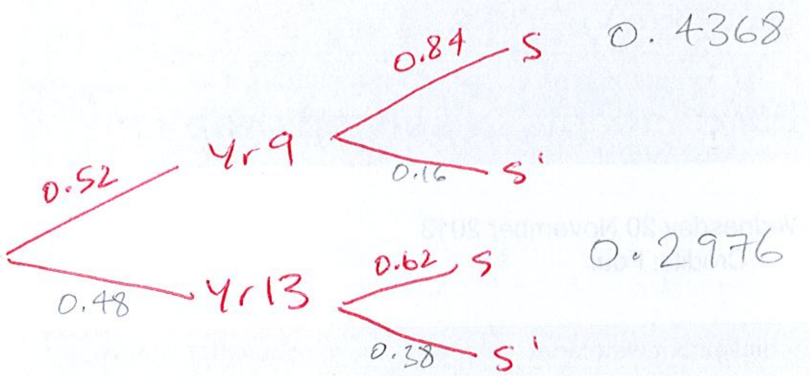
QUESTION ONE: SPORTS

(a) A local school has decided to hold a sports week. Two different year levels of students (Years 9 and 13) were surveyed before the sports week, and students were asked if they played any sports:

- 52% of the students surveyed were Year 9 students
- 84% of the Year 9 students surveyed said that they played at least one sport
- 62% of the Year 13 students surveyed said that they played at least one sport.

(i) What percentage of the students surveyed said that they played at least one sport?



0.4368 + 0.2976 = 0.7344

73.44%

A

(ii) If a student randomly selected from those surveyed said that they played no sports, are they more likely to be a Year 9 or a Year 13 student?

Support your answer with appropriate statistical statements.

P(Yr9 ∩ no sport) = 0.0832

P(Yr13 ∩ no sport) = 0.1824

∴ Student is more likely to be a Yr13 if they play no sport.

M

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(b) The three most popular sports played at the school are netball, tennis and kilikiti.

Of the 195 students at the school:

- 45 students do not play netball, tennis, or kilikiti
- 5 students play netball, tennis, and kilikiti
- 8 students play tennis only
- 20 students play both tennis and netball, and may also play kilikiti
- 12 students play both tennis and kilikiti, and may also play netball
- 35 students play both netball and kilikiti, and may also play tennis
- 50 students play kilikiti.

(i) Calculate the percentage of students at the school who play tennis.

		N	N'	
T	K	5	12-5 7	35
	K'	20-5 15	8	
T'	K	35-5 30	8	160
	K'	77	45	
		127	68	195

$$\frac{35}{195} = 0.1795$$

$\therefore$ 17.95%

M

(ii) If two different students from the school are selected at random, without replacement, calculate the probability that they both play netball.

$$\frac{127}{195} \times \frac{126}{194} = 0.4230$$

E

QUESTION TWO: INJURIES

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(a) The results of the 2007/08 Active NZ Survey, and data collected by the Accident Compensation Corporation (ACC) during the period 1 July 2007 to 30 June 2008, have been used to create the following table:

Estimates for New Zealand adults	Tennis	Netball
Number who played this sport	311 662	123 994
Number of players injured while playing this sport	7354	15 143

(i) Is a New Zealand adult more likely to be injured while playing tennis or while playing netball?

Support your answer with appropriate statistical statements.

$P(inj/net) = \frac{15143}{123994} = 0.1221$

$P(inj/tennis) = \frac{7354}{311662} = 0.0236$

∴ more likely to be injured playing netball

A

(ii) With regards to **probability theory**, explain why it is not possible to use this information to calculate the probability of a New Zealand adult being injured while playing tennis OR netball.

$P(N \cup T) = P(N) + P(T) - P(N \cap T)$

We don't know this

M

(b) During sports week at a local school, the school nurse recorded information about injuries.

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(i) Let A be the event "a student is injured playing tennis".
Let B be the event "a student is injured playing netball".

From the information the school nurse has recorded, it can be deduced that:

$P(A \cup B) = 0.35$ and $P(A \cup B') = 0.90$.

Determine the proportion of students who were injured playing tennis during sports week.

$P(A \cup B) = 0.35$

	A	A'
B	0.35	
B'		0.65

$P(A \cup B') = 0.9$

	A	A'
B		0.1
B'	0.9	

	A TI	A' T
B NI		0.1
B' N		0.65
	0.25	0.75	1

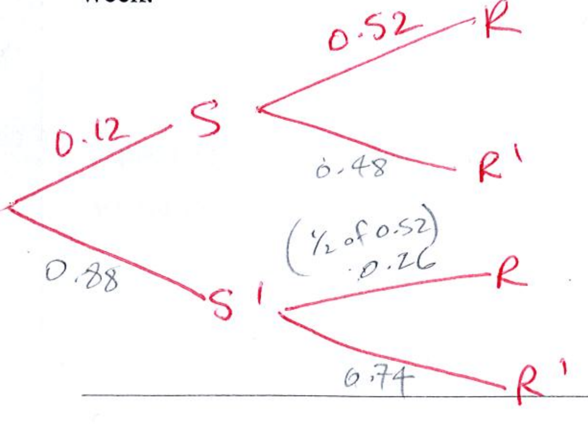
P(inj tennis) = 0.25

E

(ii) The nurse's records also show that:

- 12% of the injuries obtained were serious
- of the students who were seriously injured, 52% were injured while playing rugby
- students were twice as likely to be have been playing rugby if they were seriously injured than if they were not seriously injured.

Calculate the probability of a student being injured while playing rugby during sports week.



M

P(inj play rugby) = (0.12 × 0.52) + (0.88 × 0.26)

= 0.2912

QUESTION THREE: GAMES

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(a) Players are strongly advised to warm up before playing sports games to reduce their risk of injury from playing the game.

For a particular sports team of 20 players:

- 14 of the players warmed up before the last game
- 5 of the players were injured during the last game
- 2 of the players did not warm up and were not injured during the last game.

Using this information, calculate the probability that a randomly chosen player from the team was injured, given that the player did not warm up before the last game.

	W	W'	
I	1	4	5
I'	13	2	15
	14	6	20

~~$P(W' \cap I)$~~

$P(I / W') = \frac{4}{6}$

M1

Question Three continues on the following page.

(b) At a local school, a board game is played during lunch break. Each turn consists of rolling a single six-sided die. The player moves as many squares as shown on the top face of the die. To finish the game, a player must roll the exact number required to land on the final square, numbered 100. If the die shows a number greater than the remaining number of squares, the player cannot move, and must wait until their next turn to try and finish the game.

For example, if a player is on square 97, they could finish the game in one roll by rolling a 3. They could finish the game in two rolls, either by rolling a 2 on the first turn, and then rolling a 1 on the second turn, or by rolling a 5 on the first turn (which means they cannot move for that turn), and then rolling a 3 on the second turn.

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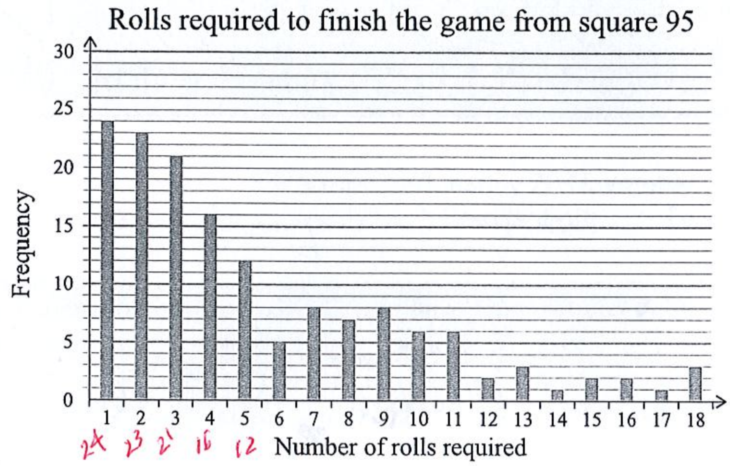
(i) A student designed a computer simulation to investigate the distribution of the number of turns needed to finish the game from **square 95.**

150 trials are carried out. The results are graphed below.



Use these results to estimate the probability of finishing the game from **square 95** in 5 or fewer rolls.

$\frac{96}{150} = 0.64$

A

(ii) Explain why the theoretical probability of finishing the game from **square 95** in exactly two rolls is $\frac{5}{36}$.

(1, 4)
(2, 3)
(3, 2)
(4, 1)
(6, 5)

5/36

M

(iii) Another student at the school thinks that the formula below can be used to find the theoretical probability of finishing the game from **square 95** in r number of rolls.

$$P(R=r)=\left(\frac{5}{6}\right)^{r-1}\left(\frac{1}{6}\right)$$

Discuss whether this student is correct in her thinking.

You may wish to include diagrams and/or calculations as part of your discussion.

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1 roll

Theory P(rolling a 5) $= \frac{1}{6}$ ← same.

Formula $\left(\frac{5}{6}\right)^{1-1} \times \frac{1}{6} = \frac{5}{6}^{0} \times \frac{1}{6} = 1 \times \frac{1}{6} = \frac{1}{6}$

E

2 rolls

Theory $\left(\frac{5}{36}\right)$ ← see previous question ← same

Formula $\left(\frac{5}{6}\right)^{2-1} \times \frac{1}{6} = \frac{5}{6} \times \frac{1}{6} = \frac{5}{36}$

3 rolls

Theory not a five × anything except to finish × anything to finish

$\frac{5}{6} \times \frac{5}{6} \times \frac{1}{6} = \frac{25}{216}$

Formula $\left(\frac{5}{6}\right)^{3-1} \times \frac{1}{6} = \frac{25}{216}$ ← same

Therefore the formula does work and will contine.