NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 3 Mathematics and Statistics (Statistics), 2015

91585 Apply probability concepts in solving problems

2.00 p.m. Thursday 19 November 2015
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 room for any answer, use the space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 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
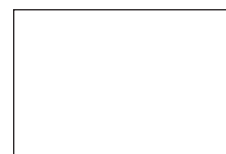
ASSESSOR'S USE ONLY

QUESTION ONE

(a) The following table shows the number of vehicles reported to the NZ Police as stolen over 2011 to 2013, and the number of vehicles registered with the NZ Transport Agency in each of these years.

	2011	**2012**	**2013**
Number of vehicles reported as stolen	20 724	17 807	19 221
Number of vehicles registered	4 210 511	4 248 612	4 315 539

(i) Which of these years had the greatest overall risk of a vehicle being stolen in New Zealand?

Support your answer with appropriate calculations.

(ii) Give ONE reason why the risks calculated in part (i) are only estimates of the true overall risk of a vehicle being stolen in that year.

(iii) A car owner wants to use the overall risk of a car being stolen in New Zealand during 2013 to estimate the risk of their own car being stolen during 2015.

Discuss what else the car owner should consider to estimate this risk.

(b) An importer of second-hand cars into New Zealand has recorded whether each car has the petrol cap on the left-hand side or the right-hand side of the car, in addition to other information about the cars.

For the last shipment of second-hand cars imported, $\frac{13}{21}$ of the cars had the petrol cap on the left-hand side and 22.8% of the cars were silver.

(i) One car is chosen at random from this shipment of imported second-hand cars.

Determine the probability that this car is silver and has the petrol cap on the left-hand side.

State the assumption you need to make to determine this probability.

(ii) A customer at a petrol station has observed that of the ten cars currently getting petrol, seven of these cars have petrol caps on the left-hand side.

Explain to the customer why a generalisation should not be made that cars in New Zealand are more likely to have petrol caps on the left-hand side, based on what the customer has observed.
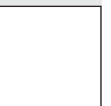
QUESTION TWO

(a)   An importer of cars into New Zealand is suspected of rounding the odometer reading (the measure of the total kilometres the car has driven) to the nearest 10 kilometres for some of the advertisements on their website.

The car importer currently has 20 cars listed for sale on their website.

The odometer readings for these cars are listed below.

1 485	25 384	25 499	26 890	29 568
35 279	47 872	49 200	64 788	68 050
72 690	75 730	84 457	91 575	92 297
93 033	109 532	113 395	137 209	142 980

(i)   What proportion of cars advertised by the importer has 0 as the last digit of the odometer reading?

(ii)   Assuming that the last digit of an odometer reading for a car is determined by chance alone, give a model (theoretical) estimate for the probability that the last digit of an odometer reading is 0.

(iii)   A concerned customer conducted a simulation to investigate the variability in the proportion of cars in sets of 20 that have 0 as the last digit of the odometer reading, based on an assumption that the last digit of an odometer reading for a car is determined by chance alone.

A summary of the simulation results is shown below (1000 trials).

Proportion with 0 last digit	$\frac{0}{20}$	$\frac{1}{20}$	$\frac{2}{20}$	$\frac{3}{20}$	$\frac{4}{20}$	$\frac{5}{20}$	$\frac{6}{20}$	$\frac{7}{20}$	$\frac{8}{20}$ or higher
Frequency	130	260	289	187	92	32	9	1	0

Based on these simulation results, what conclusion could the customer make in respect to whether or not the last digit of an odometer reading for the cars advertised is determined by chance alone?

(b) In 2013, 63.9% of imported cars registered with the New Zealand Transport Agency were manufactured in Japan. Of these cars manufactured in Japan, 80.3% were used cars.

Suppose that one of the imported cars registered with the New Zealand Transport Agency in 2013 was selected at random.

(i) Explain why the events "The car was manufactured in Japan" and "The car is a used car" are not mutually exclusive.

Include statistical reasoning in your explanation.

(ii) Explain why it can be deduced from this information alone that the car selected is more likely to have been manufactured in Japan than not, given the car selected is a used car.
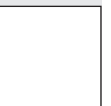
QUESTION THREE

(a)   People take their cars to testing centres for a Warrant of Fitness (WOF).

Three testing centres were recently reviewed over a one-month period: testing centre A, testing centre B, and testing centre C. During this time, all results for tests completed by each of the testing centres were recorded.

40% of the tests reviewed were completed by testing centre A, and 25% of the tests reviewed were completed by testing centre B.

Of the tests completed by testing centre A, 82% were successful (the car passed the WOF).
Of the tests completed by testing centre B, 96% were successful.
Of the tests completed by testing centre C, 94% were successful.

(i)   What percentage of tests completed during the review were successful?

(ii)   Of the tests that were unsuccessful, what proportion were completed at testing centre C?

You may wish to assume that there were 10 000 tests completed during the review of the three testing centres.

(iii) Based on the results of the review, a car owner has decided that they should take their car to testing centre B to increase their chances of having a successful WOF test.

Is this decision justified?

(b) Information about the ages of cars and motorcycles registered with the New Zealand Transport Agency (NZTA) at the end of 2013 is presented in the table below. This table shows information about only cars or motorcycles less than 5 years old at the end of 2013.

	Age of vehicles registered with NZTA at the end of 2013				
	0 years old	**1 year old**	**2 years old**	**3 years old**	**4 years old**
Proportion of cars	0.238	0.223	0.188	0.186	0.165
Proportion of motorcycles	0.215	0.181	0.177	0.183	0.244

One car and one motorcycle are chosen at random from vehicles registered with NZTA at the end of 2013.

Given that both vehicles are less than five years old, estimate the probability that the motorcycle is at least two years older than the car.

Support your answer with appropriate statistical statements and calculations.

| Extra paper if required. |
| Write the question number(s) if applicable. |

QUESTION
NUMBER

91585