Assessment Schedule – 2021

Mathematics and Statistics: Demonstrate understanding of chance and data (91037)

Evidence

Q ONE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)(i)	Comments selected from: • There is a positive relationship, which means as the number of registered dogs increases, the number of ACC claims tends to increase as well. • The overall relationship is moderate, as the points fan out when the number of registered dogs becomes greater. • There is an outlier / interesting value with around 9000 registered dogs and 560 ACC claims. This is the highest value of ACC claims. • Reference to differing confidence levels in predictions / strength depending on the number of dogs registered. • Cluster around 2000 – 7000 registered dogs.	ONE feature clearly identified and interpreted.	TWO features clearly identified and interpreted.	
(ii)	Straight line of best fit drawn with comments relating to doubts about its accuracy for predictions for the higher values of registered dogs. OR Piece-wise two straight lines of best fit drawn, joining around 7000 dogs, with comments to explain the decision. OR Curved line of best fit drawn, with comments to explain the decision.	Line of best fit drawn but with no explanations or comments to justify the decision.	Straight line of best fit drawn with comments that it does not model well, particularly for the higher values. OR Straight line of best fit drawn with comments that a non-linear model would be a better fit. OR A curved line of best fit drawn or piece-wise straight line of best fit model drawn, with appropriate comments to justify this choice.	

(iii)	Useful or not useful with evidence. • The predictions won't be that useful as the relationship overall seems to be moderate. (Allow the comment that the predictions will be useful, as the relationship overall is moderate.) • The relationship is strong when the number of registered dogs is less than 7000, so the predictions within this range will be useful. • The pattern becomes more and more scattered as the number of registered dogs gets larger, so predictions for those won't be useful. • The graph would be useful as it provides results from lots of different councils throughout New Zealand. • Data only for 2019/only one sample.	ONE valid statement.	TWO valid statements.	
(b)(i)	$\frac{168}{180} = \frac{14}{15} = 0.9333$	Correct answer.		
(ii)	Expected number of pit bull dogs $= \frac{6}{180} \times 20 = 0.6667$ Yes, it is unusual, as seeing 6 pit bull dogs is much greater than the expected value of only 0.6667 dogs. But there might not be an error in the data collection because: • We are not told where Narnia's beach is. Her beach may not be in Auckland. This data is only from Auckland, which may not be indicative of all NZ dogs, so a conclusion should not be made from this data alone. Maybe there are more pit bulls in her area, if not in Auckland. • This data is only from one year, which may not be indicative of all years, so a conclusion should not be made from this data alone. If Narnia is walking on her beach in a year other than 2019, maybe there were more pit bulls around then. • Sampling variability could alter these figures, so the conclusion may not be true with a greater or different sample. • Narnia cannot make a judgement based on just one walk on one particular day. • If Narnia saw 6 pit bull dogs out of 20 dogs, then the graph for 180 dogs should be showing 54 pit bull dogs, which is vastly different from the given 6 dogs. • Maybe the error is actually that Narnia does not know what a pit bull dog looks like, and she didn't actually see 6 pit bull dogs.	Correct expected value of 0.6667 pit bull dogs calculated or correct probabilities from sample and Narnia's observation. OR one reason why there might not be an error in the data collection.	• Correct expected value calculated or correct probabilities. AND • comment that Narnia's result is unusual AND • ONE reason why there might not be an error in the data collection OR • comment that Narnia's result is unusual AND • TWO reasons why there might not be an error in the data collection.	**T1 / E7** • Correct expected value calculated AND • comment that Narnia's result is unusual AND • TWO reasons why there might not be an error in the data collection. **T2 / E8** • Correct expected value calculated AND • comment that Narnia's result is unusual AND • THREE reasons why there might not be an error in the data collection, including reference to sampling variability.

(iii)	p(Jack Russell) $= \frac{21}{180} = \frac{7}{60} = 0.1167$ p(Bichon frise) $= \frac{12}{180} = \frac{1}{15} = 0.0667$ i.e. $\frac{0.1167}{0.0667} = 1.75$ So not quite twice as likely, but not far off. The claim is not strictly true. Also the data in the graph is only for Auckland City Council dogs, but the article claims it is twice for the whole of New Zealand. Claims such as this cannot be made from this data alone.	Probability for Jack Russell calculated OR probability for Bichon frise calculated OR 1.75 times found OR 1 comment.	Relative probability of 1.75 times found AND comments regarding the claim being untrue as the probability is only 1.75 times not 2 times OR the data provided is only for Auckland, not whole of New Zealand.	

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1 of u	2 of u	3 of u OR 1 of u and 1 of r	4 of u OR 2 of u and 1 of r	2 of r	3 of r	T1	T2

Q TWO	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a) (i)	Median pure-breed = 4063.5 dogs. Mean pure-breed = 4512.8 dogs. Use median, as it is more reliable than mean, especially as there is an extreme value / outlier / unusual value in this set of data.	Choice of median, with brief valid reason.		
(ii)	**Centre** The median / mean of pure-breed dogs is higher than the median / mean of crossbreed dogs. (must state the values) **Shift** The middle 50% box for the pure breeds is to the right of the middle 50% box for the crossbreeds. **Shape** The distribution of both pure breeds and cross breeds are right skewed / not symmetrical. **Spread** Both pure-breed dogs and crossbreed dogs have similar spread (accept slightly greater) of the middle 50% boxes (IQR). The IQR of pure breeds is 3417 and the IQR of crossbreeds is 2920. (Must provide values.) **Unusual points** There is one council with a much larger number of both types registered.	ONE valid statement about ONE significant feature.	TWO valid statements about TWO different significant features.	**T1 / E7** THREE valid statements about THREE different significant features. OR TWO valid statements about TWO significant features AND correct claim (i.e. part (iii)) with clear justification.
(iii)	The claim is likely to be false, as there is actually a difference between the number of pure-breed and crossbreed dogs per council. • The pure-breed median is 4063.5 dogs per council and the crossbreed median is 2408 dogs per council, which implies that there are more pure breed dogs than crossbreed dogs per council. • OR by comparing the means (4512.8 v 2743.8 dogs). • This sample indicates that the number of pure-breed dogs per council tend to be more than the number of crossbreed dogs per council, because the medians of both types of dogs are outside each other's middle 50% box (or equivalent) (Must have numerical justification.) OR because of calculating and interpreting the DBM and OVS values. Because DBM (1655.50) ÷ OVS (4914.50) is greater than 1/3.	Decision that the claim is false, concluding that pure-breed dog numbers are greater than crossbreed dog numbers, with reason based on comparison of medians or means.	Decision that the claim is false, concluding that pure-breed dog numbers are greater than crossbreed dog numbers, with reason based on comparison of medians AND with reference to the IQR boxes.	**T2 / E8** THREE valid statements about THREE different significant features AND correct claim (i.e. part (iii)) with clear justification.

(iv)	I would not be confident about the conclusion being the same, as the sample size is too small. The smaller the sample size, the bigger the sampling variability, therefore I would not be confident to reach the same conclusion.	Comment that the same conclusion may not be the same, as the sample size is too small to provide reliable conclusions.	Comment that the same conclusion is not likely to be the same, with the justification linked to sample size and sampling variability.	
(b)(i)	$\frac{50}{190} = \frac{5}{19} = 0.2632$	Correct answer.		
(ii)	$\frac{84}{120} = \frac{7}{10} = 0.7$		Correct answer.	
(iii)	$\frac{70}{190} \times \frac{69}{189} = \frac{23}{171} = 0.1345$ If no working is shown as a decimal, answer must have at least 4 decimal places.	70 / 90 OR $\frac{70}{190} \times \frac{70}{190} = \frac{49}{361}$ = 0.1357	Correct answer.	

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1 of u	2 of u	3 of u OR 1 of u and 1 of r	4 of u OR 2 of u and 1 of r	2 of r	3 of r	T1	T2

Q THREE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)(i)	The highest amount of money in claims was in 2018 with around $ 3 600 000.	Correct answer with brief justification.		
(ii)	Acceptable prediction, within the range of $ 3 300 000 to $ 4 000 000. However, the prediction will not necessarily be very accurate, as the trend could alter in the years ahead, as happened in 2008/9.		Valid prediction with some evidence of method. E.g. extending the trend line.	
(iii)	Features identified with numerical evidence. **Overall Trend:** The total amount of money in ACC claims has an overall increasing trend from approximately $ 1 400 000 in 2001 to $ 3 600 000 in 2018. (i.e. $ 2 200 000 in 18 years i.e. approximately $ 120 000 per year). **Piece-wise features:** The rate of increase between 2001 and 2008 ($ 1 900 000 in 7 years i.e. approximately $ 270 000 per annum) is much higher comparing to the rate of increase between 2009 and 2018 ($ 1 500 000 in 9 years i.e. approximately $ 170 000 per annum). **Peak:** There is an unusual spike / peak in 2008 where the amount of money claimed from the ACC reached approximately $3 300 000. **Trough:** Following the spike, there is a sharp drop in 2009 where the amount of claims reduced to approximately $ 2 100 000.	ONE feature identified.	TWO features clearly identified with some appropriate numerical evidence.	**T1 / E7** THREE features clearly identified with some numerical evidence. **T2 / E8** THREE features clearly identified with some numerical evidence AND including at least one rate of change calculated (or equivalent).
(b)	The gap between ACC claims in Auckland and the other two cities has been widening since 2010. OR From 2009 to 2018, ACC claims in Auckland have been increasing at a much steeper rate than the other two cities. Therefore it's likely to widen even further if the trend continues.	A statement about a wider gap OR A statement about a steeper increase.	Used the past evidence to predict a wider gap in the future.	

(c)	Because Auckland is the largest city in New Zealand, with the largest population and the highest number of dogs, a much higher percentage of dog-related claims occurred in Auckland compared to other cities. Auckland contributes to the highest proportion for the whole country, so the trend for Auckland will tend to dominate the trend for the whole of New Zealand.	A statement about Auckland having the greatest population and therefore greatest number of dogs.	A clear statement that links to Auckland having the highest contribution to / proportion of the overall trend for the whole of New Zealand.	

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1 of u	2 of u	3 of u OR 1 of u and 1 of r	4 of u OR 2 of u and 1 of r	2 of r	3 of r	T1	T2

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 8	9 – 13	14 – 18	19 – 24