Assessment Schedule – 2022

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

Evidence

Q	Evidence	Achievement	Merit	Excellence
ONE (a)(i)	13 November 2009	Correct answer.		
(ii)	P(less than 10 °C) $= \frac{1}{30} = 0.0333$	Correct answer.		
(iii)	• The average daily temperatures (trend line) in 2019 varied more than 2009, as we can see 2019 trend line went up at the start of the month then dipped down around 11th and 20th before going up again. Whereas 2009 remained at a fairly consistent upward trend. • The average temperatures in 2019 were higher than 2009, as a large proportion of recorded temperature in 2019 is sitting above 2009's temperature. • Majorities of 2019 max temperatures are higher than 2009 max temperatures. There are only two days where 2009 max temperature were noticeably higher than 2019 – 12th and 21st November; more than half of the month max temperature exceeds 20 °C in 2019, compared to only 5 days in 2009. • The daily temperature differences (fluctuation) in 2019 seems to be larger than 2009. The daily temp fluctuation in 2009 are all less than 10 °C except one day (12th) whereas there are many days in 2019 exceeding 10 °C daily temp difference. • There are two days in 2019 where max temperature didn't peak from the previous day (11th and 19th). There was not much difference between the min temperature on the previous day and max temperature on the following day.	Any one sensible feature identified. Accept omission of justification.	Any two sensible features identified with attempt to justify.	T 1: Any three sensible features identified with attempt to justify. T 2: Any three sensible features identified with clear justification.

(b)(i)	P(both more than 20 °C) $= \frac{3}{30} \times \frac{11}{31} = \frac{11}{310} = 0.035$	One correct probability found.	Correct answer.	
(ii)	NIWA's claim is not valid, as the data used is only from one year. 2019 could be quite different to other recent years, the proportion of hot days is likely to vary from year to year. Since there are only 61 days in November and December, the probability of hot days can be easily impacted by a couple of extra hot days. The data does not make it clear what type of average was used. If it was mean, then the results could be distorted by an extreme result. Forecasting ahead from 2019 to 2022 can be risky, as perhaps average temperatures are changing over time. Allow other valid statistical reasons.	One valid reason, with justification.	Two valid reasons, with justification.	

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	One partial solution	1 of u	2 of u	3 of u	1 of r	2 of r	t1	t2

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	1940 – 1950 Allow other possibilities.	Correct answer.		
(ii)	Frequency of positive anomalies : • Much higher proportion of recent years than the annual average temp anomalies were above the baseline. • Before 1970, the annual average temp anomalies only occasionally jumped above zero. In contrast, the anomalies were rarely below zero in recent years. Amplitude of the anomalies : • The anomalies in the past rarely exceeded 0.5 °C. In recent years, a lot of anomalies were above 0.5 °C and close to 1 °C. Allow other valid statistical reasons.	ONE valid feature identified and justified.	TWO valid features identified and justified.	Any THREE valid features identified and justified.

(b)(i)	The temperature in Auckland in 2019 is approximately 16.1 °C.	Correct temperature value stated.		
(ii)	Prob $= \frac{9}{54} \times \frac{8}{53} = \frac{4}{159} = 0.0252$	Probability of $\frac{9}{54}$ found.	Probability evaluated.	
(iii)	Comments selected from: • There is a positive relationship, which means as the temperature in Auckland increases, the temperature in Wellington tends to increase as well. • The relationship seems to be a linear one. • The overall relationship is moderate, as the points do not form a close band throughout the graph. • There is an interesting value with the Auckland temperature being almost 16.6 °C whereas Wellington is much cooler, at only just under 13.8 °C. This is the year with the highest annual average temperature. OR There is a much cooler annual average temperature for Auckland of approximately 14.9 °C, which is also the coolest temperature for Wellington. • The strength of the relationship is reasonably even throughout the graph. There are no obvious clusters / groups.	ONE feature clearly identified with some interpretation. OR valid comment with some justification. CAN BE FROM (iii) OR (iv).	TWO features clearly identified with some interpretation. OR valid comments with some justification. CAN BE FROM (iii) OR (iv).	THREE features clearly identified with some interpretation. OR valid comments with some justification. CAN BE FROM (iii) OR (iv).
(iv)	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.) • Is useful, because the graph provides results from many years of relevant data. • Is useful, as we can see that the Wellington temperatures generally tend to be a few degrees cooler than the Auckland temperature. • Not useful, as there are some sections of the graphs with not enough data to see what the relationship should be. • Not useful particularly at the higher and lower temperatures, as there are less data values recorded. • Not useful, because data provided is only temperatures but temperature is not the only indicator for "weather". Associated wind strength and rainfall is also needed.			

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	One partial solution	1 of u	2 of u	3 of u	1 of r	2 of r	t1	t2

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	IQR = UQ – LQ = 11.69 – 11.05 = 0.64 °C This gives the amount of variation of the middle 50% of the temperatures for Dunedin for the years after 1980.	Correct value with brief interpretation.		
(ii)	• **Centre**: the median temperatures before 1980 and after 1980 are very similar, being 11.28 °C and 11.33 °C respectively. • **Shift** The middle 50% box overlaps each other completely. • **Shape:** both distributions of temperatures appear to be symmetrical. Or After 1980 skewed slightly left and/or Before 1980 skewed slightly right. • **Spread**: the temperatures after 1980 are more spread out than before 1980. IQR for after 1980 is 0.64 °C comparing to IQR of 0.44 °C for before 1980. Or could use range, After 1980 2, Before 1980 1.33. • **Unusual/Outliers.** These need to be numerical.	One feature compared.	Two features compared, with some numerical evidence included.	Three features compared, including appropriate relevant numerical evidence.
(iii)	The claim is not valid. • Because the data was only collected from one city in New Zealand, which cannot accurately represent the entire country. • Box plot is not a suitable graph to analyse the change in trend, as a time series graph would be more appropriate. • There is not a logical statistical reason to split the two sets of data by year pre and post 1980.	Rejected claim with an attempt to justify.	Rejected claim with TWO reasons, clearly justified.	
(b)	The statement is justified. • Majority of New Zealand in February and June were in dark red (well above average). • In February, June, August, October, and November (5 out of 12 months), almost the entire country were warmer than average. • Only one month (March), a noticeable proportion of New Zealand was cooler than usual. The rest of the months, the temperatures were either similar or warmer than the average.	A valid reason.		

(c)(i)	P(rain on both Sat and Sun) = 0.2 × 0.1 = 0.02 = 2% = $\frac{1}{50}$	Correct answer.		
(ii)	P(rain Monday and no rain Tuesday) = 0.7 × 0.4 = 0.28 P(no rain Monday and rain Tuesday) = 0.3 × 0.6 = 0.18 P (rain on both days) = 0.7 × 0.6 = 0.42 Overall required probability = 0.28 + 0.18 + 0.42 = 0.88 = $\frac{22}{25}$ = 88 %	One probability found with evidence of calculation.	Two probabilities found. OR Correct Answer Only.	Correct answer, with justification.

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No response; no relevant evidence.	One partial solution	1 of u	2 of u	3 of u	1 of r	2 of r	t1	t2

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 18	19 – 24