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Level 1 Mathematics and Statistics 2022

91037 Demonstrate understanding of chance and data

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of chance and data.	Demonstrate understanding of chance and data, justifying statements and findings.	Demonstrate understanding of chance and data, showing statistical insight.

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.

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 2–20 in the correct order and that none of these pages is blank.

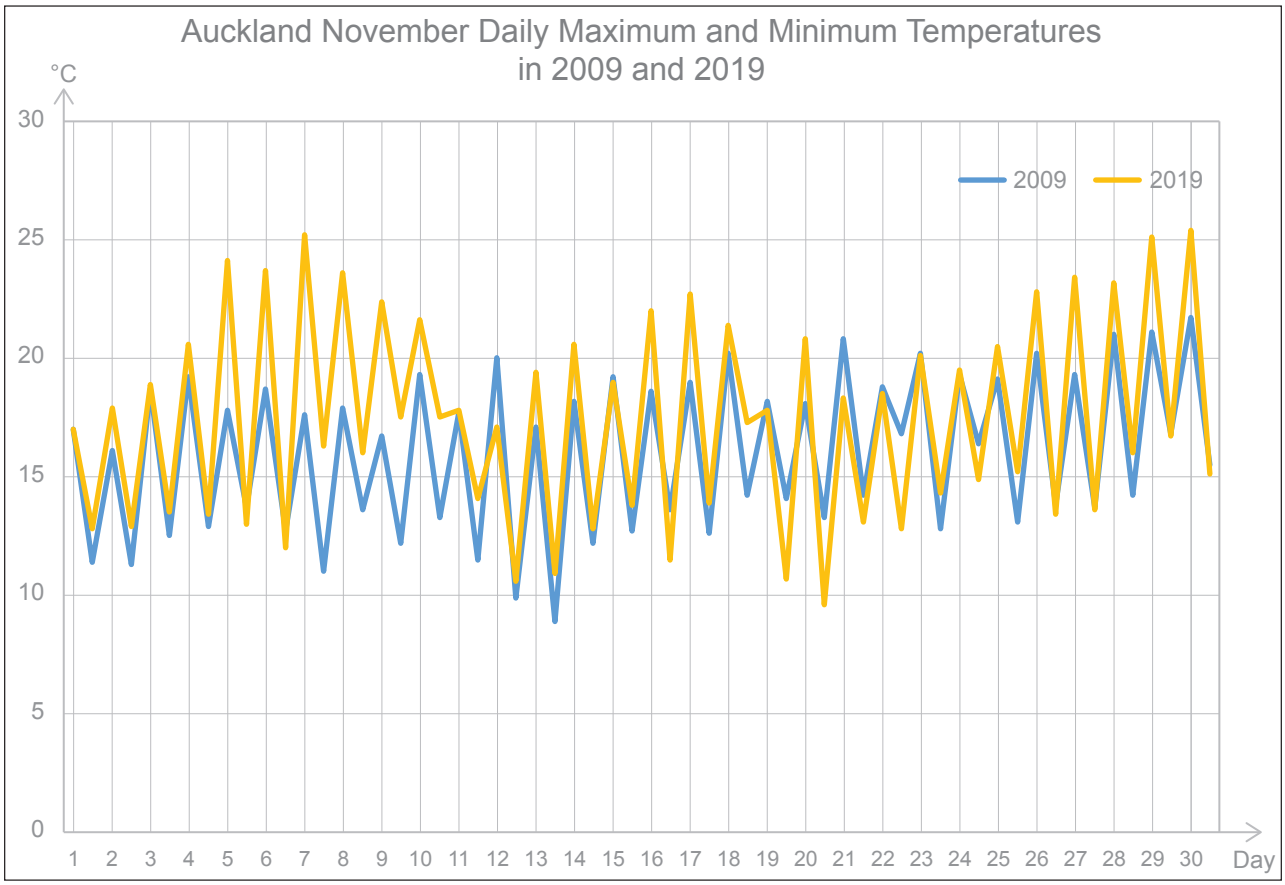
Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

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

QUESTION ONE

(a) NIWA, the National Institute of Water and Atmospheric Research, has been collecting data on the weather since 1992.

The November daily maximum and minimum temperatures in Auckland recorded in 2009 and 2019 are displayed below.



(i) Using the data provided, what was the date when the daily temperature recorded was the coolest?

(ii) Based on the 2019 data, what is the probability that there was a minimum temperature lower than 10 °C on a randomly selected day in November?

(iii) Compare the daily temperatures in 2009 and 2019.

- Clearly identify any significant features in this graph.
- Discuss any trends and unusual features that you notice in the graph.
- Provide evidence from the graph to back up your statements.
- Justify your answer using statistical reasons, giving at least THREE different supporting statements.

(b) The table below shows the daily average temperatures recorded in Auckland in 2019.

	Less than 17 ºC	**Between 17 ºC and 20 ºC**	**More than 20 ºC**	**Total**
November	13	14	3	30
December	2	18	11	31
Total	15	32	14	61

(i) If one day in November and one day in December 2019 is randomly selected, find the probability that both days were more than 20 °C.

Give your answer as a fraction or a decimal correct to 4 decimal places.

(ii) Based on this data from 2019, NIWA claims that the average temperature in November 2022 and December 2022 will be similar.

Comment on NIWA's claim.

Justify your answer using statistical reasons, giving at least TWO different supporting statements.

QUESTION TWO

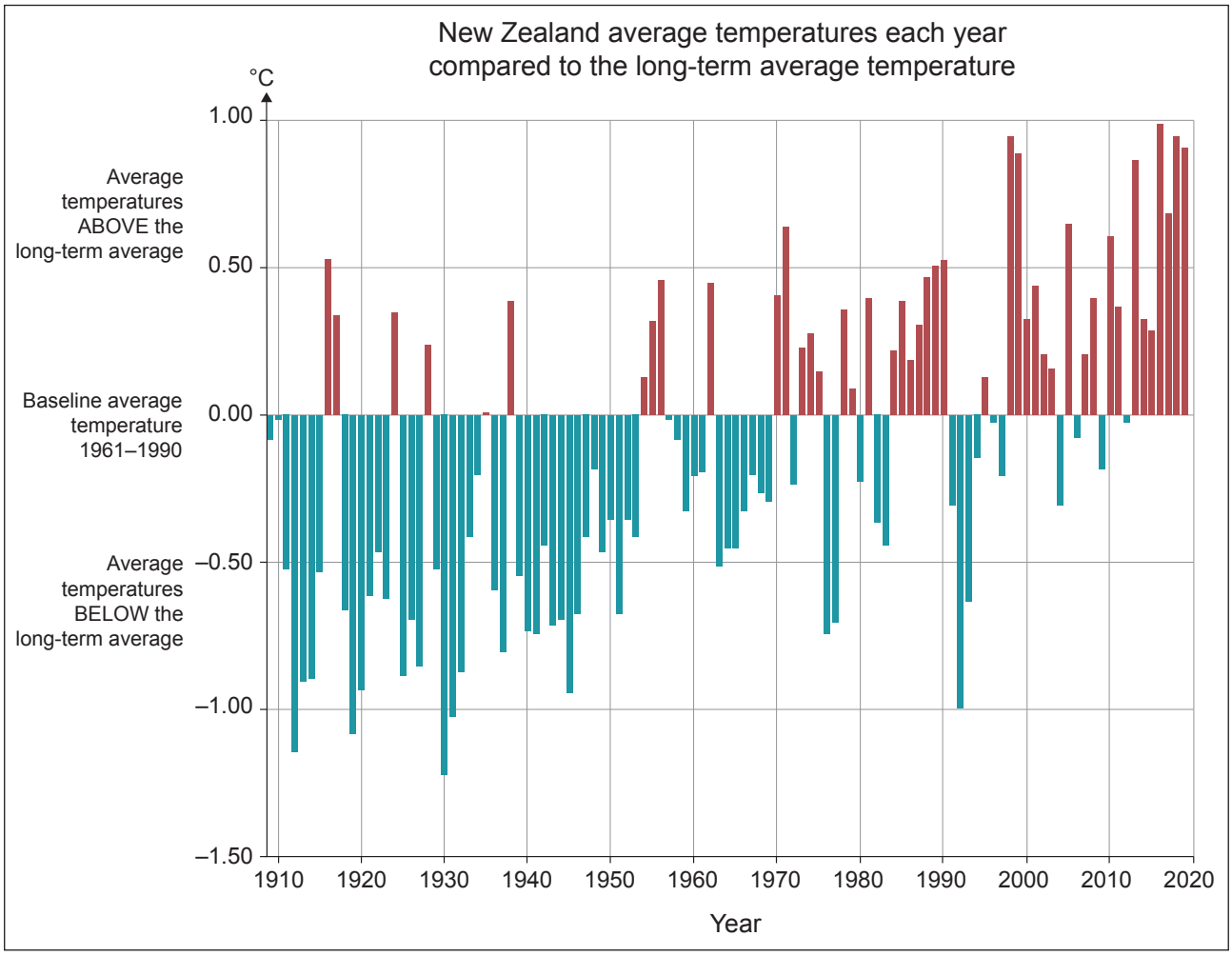
(a) The average annual temperature in New Zealand between 1909 and 2019 is recorded on the graph below.

The average temperature from individual years is compared to the long-term average temperature.

The long-term average temperature is the average temperature between 1961 and 1990.

A year with its average temperature in red means that its average temperature was above the long-term average.

A year with its average temperature in blue means that its average temperature was below the long-term average. For example, in 1992, the average temperature was 1 °C below the long-term average temperature.



(i) Based on the data displayed above, identify in which 10-year period the average temperatures were all below the long-term average.

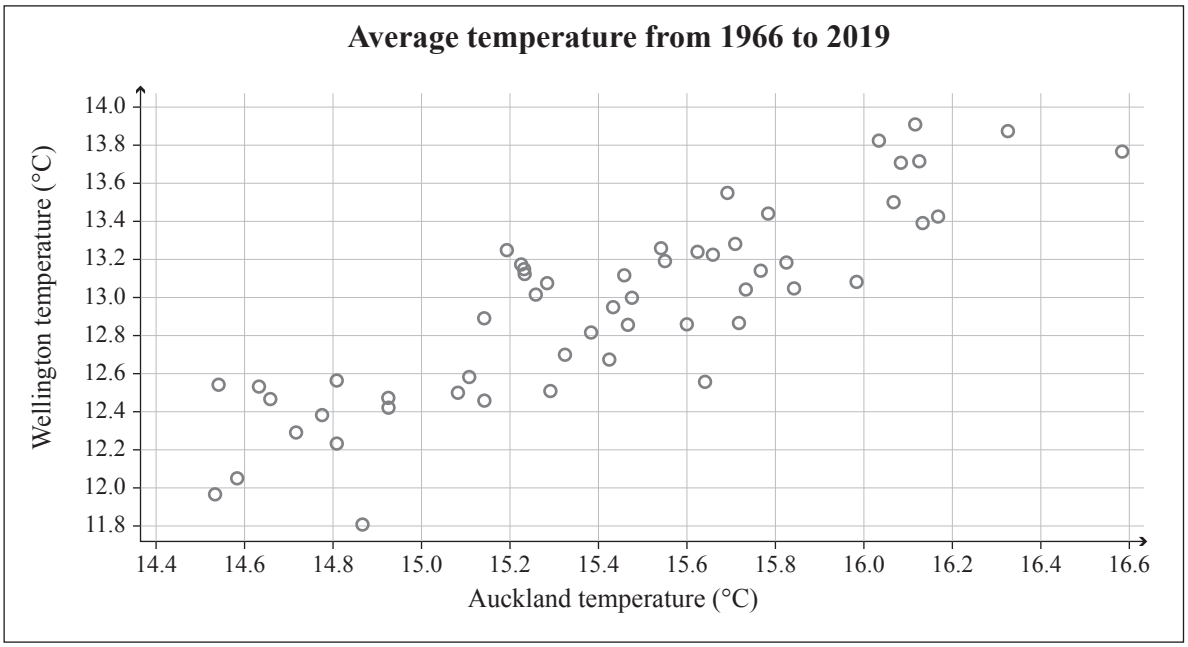
(ii) Many newspaper articles have been published in recent years regarding the concern that temperatures in New Zealand are rising.

Identify features from the graph that can be used as evidence to support this claim.

Justify your answer using statistical reasons, giving at least THREE different supporting statements.

(b) The graph below displays the relationship of average temperatures in °C between Wellington and Auckland.

Each dot represents the average temperature for one year (in °C).



(i) The highest average temperature for Wellington was recorded in 2019.

State the average temperature for Auckland in 2019.

(ii) The graph shows the average temperatures for the 54 years between 1966 and 2019.

If two years are randomly chosen between 1966 and 2019, what is the probability that the Auckland average temperatures in both years are above 16 °C?

Show your working clearly.

Give your answer as a fraction or as a decimal correct to 4 decimal places.

(iii) Describe and interpret at least two different features visible in the graph of "Wellington Temperature" versus "Auckland Temperature" shown on the facing page.

(iv) How useful is this graph to predict the weather in Wellington and Auckland?

Justify your answer using statistical reasons, giving at least TWO different supporting statements.

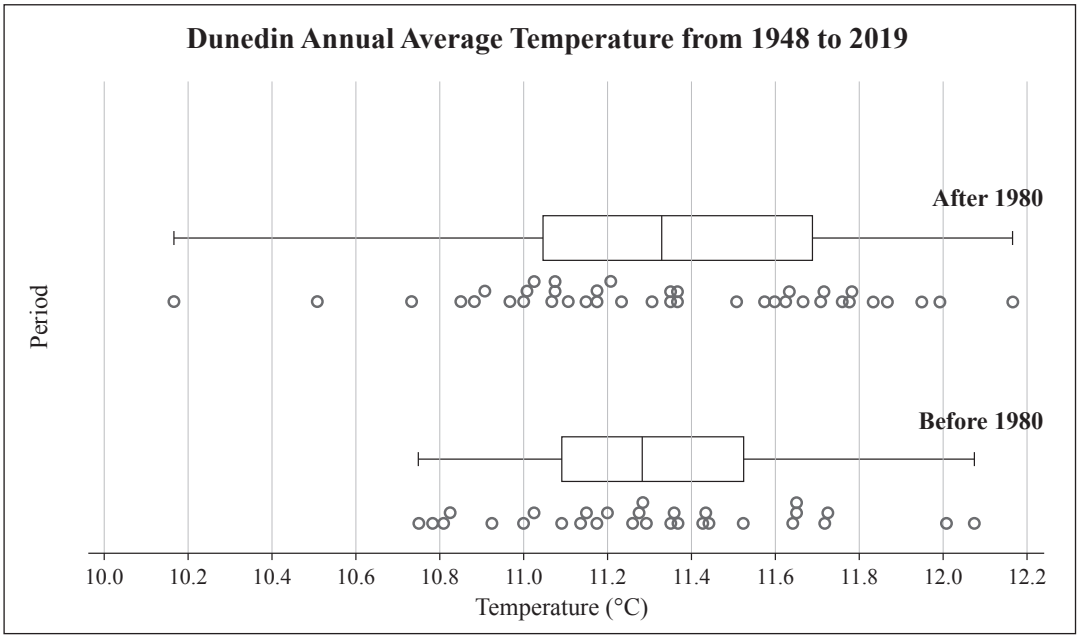
QUESTION THREE

(a) The graph below compares the annual average temperatures recorded in Dunedin before 1980 and after 1980.

Each dot represents the average temperature for one year (in °C).

Period	Minimum	LQ	Median	Mean	UQ	Maximum	Number of pieces of data
After 1980	10.17	11.05	11.33	11.33	11.69	12.17	40
Before 1980	10.75	11.09	11.28	11.31	11.53	12.08	31*

*1952 has been removed from this dataset because no data of the average temperatures were recorded for that year.



(i) Calculate the Inter-Quartile Range (IQR) for the Dunedin average temperatures for "After 1980".

Comment on how this value could be used in an analysis.

(ii) Compare the distributions of the Dunedin average temperatures, before and after 1980.

Note any similarities and differences considering centre, shift, shape, spread; and provide numerical evidence where appropriate.

In your answer, describe at least THREE different key features.

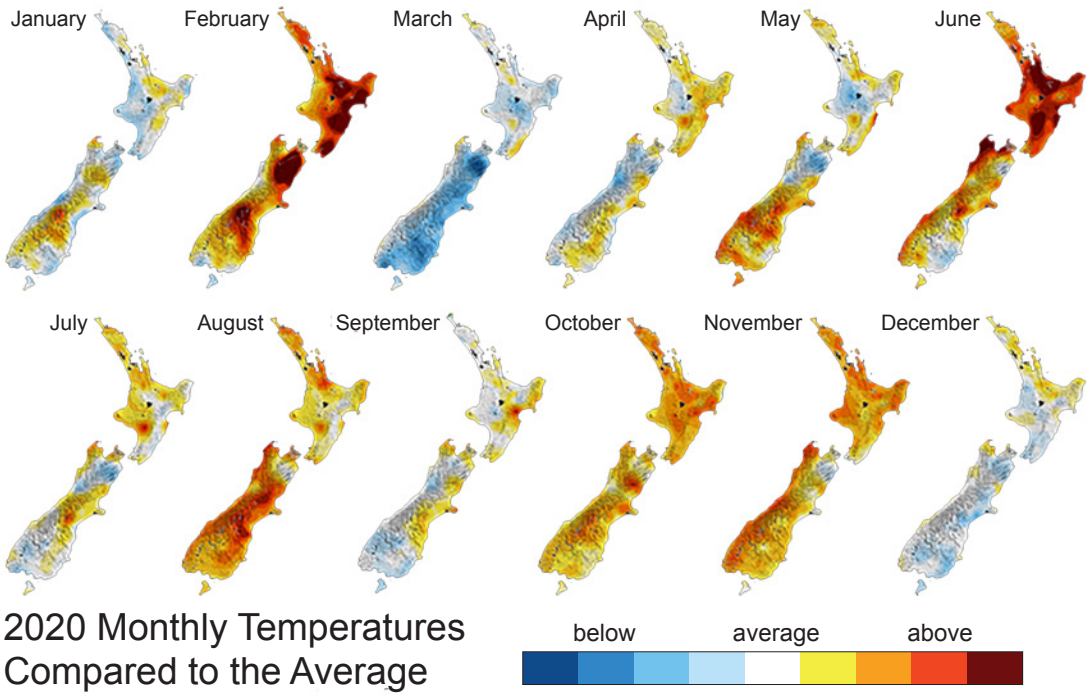
Question Three continues on the following page.

(iii) One Dunedin community group claims that New Zealand has not become hotter, since the median temperatures before 1980 and after 1980 are very similar.

Comment on this claim, based on the sample of temperatures provided.

Justify your answer using statistical reasons, giving at least TWO different supporting statements.

(b) The graph below is from a 2020 story on the website of Radio New Zealand using data provided by NIWA.



Adapted from: www.rnz.co.nz/news/national/434389/2020-new-zealand-s-seventh-warmest-as-weather-anomalies-continue

The story has the heading "NIWA figures show temperatures were well-above average".

Comment on this claim, based on the information provided in this graph.

Justify your answer using statistical reasons, giving at least TWO different supporting statements.

Question Three continues on the following page.

(c) A weather forecast predicts the chance of rainfall for the following week in the table below.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Chance of rainfall	70%	60%	50%	40%	30%	20%	10%
							

(i) What is the probability that it will rain on both Saturday and Sunday?

(ii) What is the probability that it rains on either Monday or Tuesday, or both days?

Extra space if required.
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