

External assessment 2022

Stimulus book

General Mathematics SEE

SEE 1

General instruction

- Work in this book will not be marked.

Context

Modelling climate change

Climate change has been described by the United Nations as ‘the defining issue of our time’ and is thought to be predominantly driven by increasing concentrations of atmospheric carbon dioxide. Modelling changes in global average temperature of the Earth’s surface in response to changes in atmospheric carbon dioxide is therefore a critical scientific endeavour.

However, the global climate system is naturally variable, making it a challenge to formulate accurate mathematical models of global temperatures for the future. One of the strongest indicators of yearly climate variability is the El Niño-Southern Oscillation (ENSO). The phase and strength of the ENSO is commonly measured by the NINO3.4 value.

Stimulus 1

The time series graphs show annual values for NINO3.4 index, atmospheric carbon dioxide concentration in parts per million (ppm) and temperature anomaly ($^{\circ}\text{C}$)¹ from 1985 to 2010.

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Graph 2

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Graph 3

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Stimulus 2

The NINO3.4 index can experience considerable seasonal variation. A scientist calculates the relevant NINO3.4 index and compares it to atmospheric carbon dioxide concentration (ppm) and the observed temperature anomaly ($^{\circ}\text{C}$) from 2011 to 2019.

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Stimulus 3

The table summarises the relationship between ENSO phase strength and NINO3.4 index.

ENSO phase strength	NINO3.4 index
La Niña	Less than -0.8
Neutral	Between -0.8 and 0.8
El Niño	Greater than 0.8

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References

Stimulus 1

Graph 1: Data sourced from Climate Prediction Centre 2021, Nino 3.4 mean, NOAA, Physical Science Laboratory, <https://psl.noaa.gov/data/correlation/nina34.data>.

Graph 2: Data sourced from NOAA 2021, Monthly average Mauna Loa CO₂, Global Monitoring Laboratory, <https://gml.noaa.gov/ccgg/trends/>.

Graph 3: Data sourced from NASA's Goddard Institute of Space Studies 2021, Global land-ocean temperature index, Jet Propulsion Laboratory, <https://climate.nasa.gov/vital-signs/global-temperature/>.

Stimulus 2

Derived from Stimulus 1 dataset.

Stimulus 3

Commonwealth of Australia 2022, 'About ENSO outlooks', Bureau of Meteorology, <http://www.bom.gov.au/climate/ahead/about-ENSO-outlooks.shtml#:~:text=NINO3.&text=4%20index%20is%20defined%20as,one%20standard%20deviation%20above%20average>



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