

Internal Assessment Resource

Mathematics and Statistics Level 3

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| This resource supports assessment against:  Achievement Standard 91580  Investigate time series data |
| Resource title: Polar ice |
| 4 credits |
| This resource:   * Clarifies the requirements of the standard * Supports good assessment practice * Should be subjected to the school’s usual assessment quality assurance process * Should be modified to make the context relevant to students in their school environment and ensure that submitted evidence is authentic |

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| Date version published by Ministry of Education | January 2021  To support internal assessment from 2021. |
| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-1-2021-91580-02-6473-1-1 |
| Authenticity of evidence | Teachers must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student exemplar material.  Using this assessment resource without modification may mean that students’ work is not authentic. The teacher may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

**Internal Assessment Resource**

Achievement Standard Mathematics and Statistics 91580: Investigate time series data

Resource reference: Mathematics and Statistics 3.8B

Resource title: Polar ice

Credits: 4

Teacher guidelines

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by Achievement Standard Mathematics and Statistics 91580. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing students against it.

Context/setting

This activity requires students to investigate the changes in the area of sea ice in polar regions.

Before the assessment students need to research the context, including details about the variables. Students need to know why the polar ice caps are important and how they reflect global environmental patterns. Time needs to be set aside for this purpose before the assessment.

For additional information about the area of sea ice in Antarctica see:

<http://www.nasa.gov/topics/earth/features/antarctic_melting.html>

<http://www.newscientist.com/article/dn16988-why-antarctic-ice-is-growing-despite-global-warming.html>

This activity could easily be adapted by substituting data for an alternative issue, for example, carbon emissions or fossil fuel consumption. Any data set provided needs to have appropriate motivation, contextual depth and relevance to the students. Details about the data need to be provided to enable students to inform themselves about the context.

Conditions

This activity requires multiple sessions. Confirm the timeframe with your students. Students will work independently.

Students need to use appropriate technology, for example, statistical software.

The format of the report could be, but is not restricted to, a presentation or a written report.

Resource requirements

Provide the students with the data file.

Additional information

The data is taken from <https://psl.noaa.gov/data/timeseries/monthly/NHICE/>

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| Achievement | Achievement with Merit | Achievement with Excellence |
| Investigate time series data. | Investigate time series data, with justification. | Investigate time series data, with statistical insight. |

Student instructions

Introduction

Polar sea ice has a huge effect on world climates. It reflects solar heat back into the atmosphere, making the air colder, while reducing heat loss from the water below the ice.

This activity requires you to investigate the area of sea ice in at least one of the polar regions of Earth, make a forecast, and write a report on your findings.

Your overall grade will be determined by how well you carry out your investigation and how well you apply the statistical enquiry cycle.

You will work independently over a period of <<teacher to insert time and conditions here>> to complete this task.

Task

Global temperatures are increasing and many scientists believe this is having an impact on the area of sea ice in the polar regions. The data provided is the mean monthly area of ice in the Arctic and Antarctica (millions of square kilometres), calculated from daily satellite images from October 1978 to January 2021. The data was downloaded in January 2021 from the National Oceanic and Atmospheric Administration (NOAA) website <https://psl.noaa.gov/data/timeseries/monthly/NHICE/>.

Use the statistical enquiry cycle to carry out a statistical investigation to determine patterns in the amount of sea ice in one of the polar regions. Write a report describing the investigation.

Use the following steps to conduct your investigation and write your report:

1. Familiarise yourself with the data set provided. This will include doing research to help you understand the variables and to develop a purpose for the investigation.
2. Select at least one of the variables to investigate.
3. Select and use appropriate display(s) to graph your data.
4. Identify features in the data and relate these to the context.
5. Find appropriate model(s).
6. Use your model(s) to make forecast(s).
7. Write a conclusion. Support your conclusion by referring to your analysis and/or features of the visual display(s). Include a reflection on your process, which could consider other relevant variables, an evaluation of the adequacy of the model(s), consideration of the validity of your forecast(s), or a deeper understanding of the model(s).

In writing your report, link your discussion to the context and support the statements you make by referring to statistical evidence.

Additional information

The data was downloaded from the National Oceanic and Atmospheric Administration (NOAA) website <https://psl.noaa.gov/data/timeseries/monthly/NHICE/> .

The data on this website includes the monthly average sea ice area from October 1978 to the presentmonth, for both the Northern Hemisphere (Arctic) and the Southern Hemisphere (Antarctic), in millions of square kilometers.

The data is from the NSIDC Sea Ice Index <https://nsidc.org/data/seaice_index/archives> using data from the Defense Meteorological Satellite Program (DMSP) series of passive microwave remote sensing instruments. The Sea Ice Index is based on the data sets, Near-Real-time DMSP SSM/I-SSMIS Daily Polar Gridded Sea Ice Concentrations (<http://nsidc.org/data/nsidc-0081>), and the NASA-produced Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I Passive Microwave Data

(<http://nsidc.org/data/nsidc-0051>).

Assessment schedule: Mathematics and Statistics 91580 Polar ice

Teacher note: You will need to adapt this assessment schedule to include examples of the types of responses that can be expected.

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The student has investigated time series data. They have shown evidence of using each component of the statistical enquiry cycle to do this.  The student has:   * selected a variable to investigate:   *For example, selected a variable to investigate from the data set with respect to an identified purpose for the investigation.*   * selected and used appropriate display(s):   *For example, graphed both the raw data and the smoothed data. Minor errors such as the omission of labels on the graph may be ignored.*   * found an appropriate model:   *For example, an appropriate model for the trend based on the smoothed data. The model might be a trend equation, a fitted trend line, or a graph of the smoothed data.*   * identified features in the data and related these to the context:   *For example, a quantitative description of the trend has been given and the seasonal pattern described and these have been related to the context. Any other relevant features are identified.*   * made a forecast:   *For example, the trend and seasonal effect are used to make forecast(s) with correct units. (A prediction interval could be included.)*   * communicated findings in a conclusion:   *For example, clearly communicated each component of the cycle. The conclusion is consistent with the purpose of the investigation.*  *The examples above are indicative of the evidence that is required.* | The student has investigated time series data, with justification. They have shown evidence of linking components of the statistical enquiry cycle to the context and referring to relevant evidence such as statistics, data values, trends, or features of visual displays in support of statements made.  The student has:   * selected a variable to investigate:   *For example, researched the context and justified the choice of variable(s) to investigate from the data set with respect to a clear purpose for the investigation.*   * selected and used appropriate display(s):   *For example, graphed both the raw data and the smoothed data. The graph(s) has a title, axes correctly labelled and any series shown on the graph(s) are clearly identified.*   * found appropriate model(s):   *For example, an appropriate model for the trend based on the smoothed data. The model might be a trend equation, a fitted trend line, or a graph of the smoothed data.* *The appropriateness of the model is justified throughout the entire range of x-values.*   * identified features in the data and related these to the context:   *For example, a quantitative description of the trend has been given and the seasonal pattern described and these have been related to the context. Any other relevant features are identified and discussed in context.*   * made a forecast:   *For example, the trend and seasonal effect are used to make forecast(s). (A prediction interval could be included.) The forecast(s) is given in context with correct units and rounded appropriately. It is justified with a discussion on how precise it might be based on the reliability of the trend or the seasonal component. Any comments made must be supported with references to statistical evidence. There is an understanding that the forecasted values are estimates.*   * communicated findings in a conclusion:   *For example, clearly communicated each component of the cycle. There is contextual support for the conclusion, which is consistent with the purpose of the investigation.*  *The examples above are indicative of the evidence that is required.* | The student has investigated time series data, with statistical insight. They have shown evidence of integrating statistical and contextual knowledge throughout the statistical enquiry cycle. They may have reflected on the process, considered other relevant variables, evaluated the adequacy of any models, or shown a deeper understanding of models.  The student has:   * selected a variable to investigate:   *For example, the research is used to develop the purpose for the investigation and appropriate variable(s) are selected.*   * selected and used appropriate display(s):   *For example, graphed both the raw data and the smoothed data correctly. The graph(s) has a title, axes correctly labelled and any series shown on the graph(s) are clearly identified.*   * found appropriate model(s):   *For example, an appropriate model for the trend based on the smoothed data. The model might be a trend equation, a fitted trend line or a graph of the smoothed data. The appropriateness of the model is justified throughout the entire range of x-values. Fitting an alternative model to specified ranges of x-values could be considered. Any alternative models would have to be justified as being an improvement in terms of how reliable they are in the making of forecasts.*   * identified features in the data and related these to the context:   *For example, a quantitative description of the trend has been given and the seasonal pattern described and these have been related to the context. Any other relevant features are identified, discussing these in context, and providing possible explanations for such features from research into the context.*   * made a forecast:   *For example, the trend and seasonal effect are used to make forecast(s). (A prediction interval could be included.) The forecast(s) is given in context with correct units and rounded appropriately. It is justified with a discussion on how precise it might be based on the reliability of the trend and the seasonal component. A comparison of the actual and predicted values for the most recent data values of the model could be made. Any comments made must be supported with references to statistical evidence. There is an understanding that the forecasted values are estimates.*   * communicated findings in a conclusion:   *For example, clearly communicated each component of the cycle. The purpose of the investigation has been addressed and there are contextual references throughout the entire investigation to support findings. There is a reflection on the analysis with respect to the background research undertaken. They may have considered the impact of their findings or made a comparison with another time series.*  *The examples above are indicative of the evidence that is required.* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.