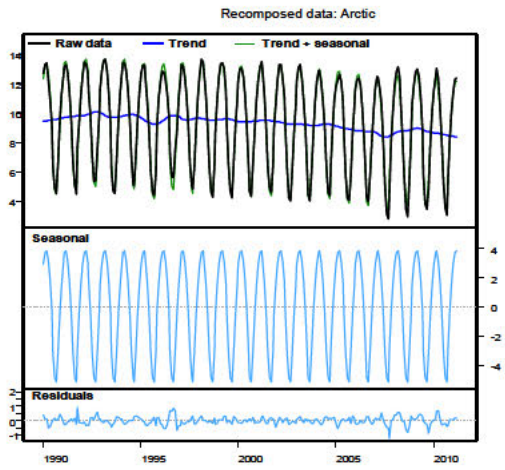
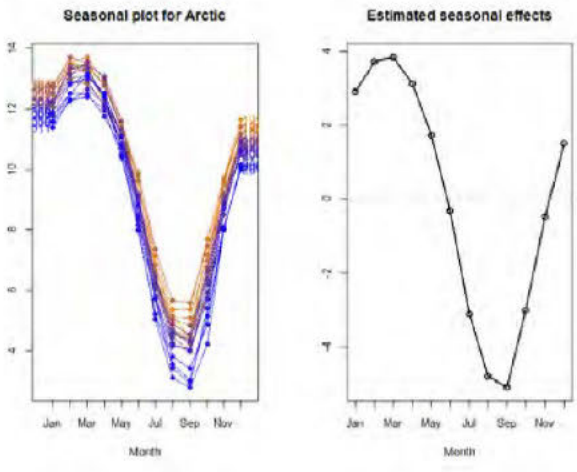
Student 2: High Merit

NZQA Intended for teacher use only

The two data sets given are about the sea ice located in the polar ice caps (Arctic and Antarctica). Polar ice caps simply mean a high altitude region in a planet or natural satellite that is covered in ice. There is no specific size nor composition for the mass of ice to be given the term "polar ice cap" for this case, the data that I've chosen is about the polar ice caps in Arctic which is mainly composed of sea ice. Sea ice is just ice made from sea, but in the process it loses its composites and eventually becomes fresh water. Since sea water is denser that fresh water so the freezing point for sea water is below 0 degrees Celsius.
It is widely known that the phenomenon of global warming is happening on our planet. This means that the average temperatures of the Earth's atmosphere and oceans are increasing. The effects of an increase in global temperature mean that sea levels rise and the amount of sea ice decreases as a result. According to Wikipedia, warming is expected to be strongest in the Arctic and would be associated with the continuing retreat of glaciers and sea ice. It would be interesting to investigate whether the area of sea ice is in fact decreasing in the Arctic, at what rate, any other interesting patterns or features and who or what will be affected by such decreases.

Mean Area Sea Ice (million square kilometres) for Arctic Graphs



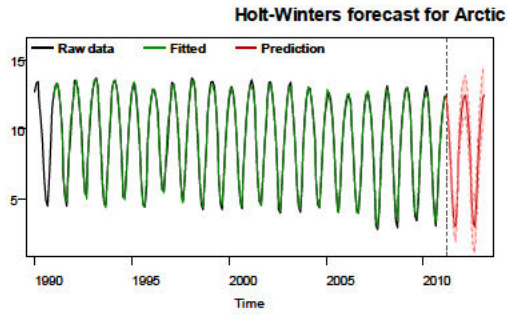


The graph shows data about the mean area of sea ice in the Arctic. Looking at the raw data the mean area of sea ice in Arctic fluctuated between 13.5 (million square kilometres) and 2.5 (million square kilometres) between 1990 to 2011. The graph of the smoothed trend shows a very gradual decreasing trend. It appears that the mean area of sea ice has decreased on average from about 9.5 million square kilometres to about 8.5 million square kilometres from January 1990 to March 2011. (1)

The graph of the estimated average seasonal effects shows a seasonal pattern with the maximum mean area of sea ice in the Arctic occurring at March which peaks at around 3.8 million square kilometres above the trend line and the minimum mean area of sea ice in the Arctic occurring at September which is at the lowest at about 5million square kilometres below the trend line. This pattern corresponds to the seasons experienced at the Arctic which is in the Northern Hemisphere. The temperatures during March, which near the end of Winter start of Spring, in the Arctic are relatively lower causing more ice to form and the temperatures during September, which is near the end of Summer start of Autumn, are relatively high causing more ice to melt. (2)

The following predictions and prediction intervals were produced from iNZight

Month	Lower limit	Prediction	Upper limit
January 2012	10.1	11.5	12.8
February 2012	10.8	12.3	14
March 2012	10.9	12.4	13.9



If this trend continues, my prediction for the mean area of sea ice in arctic in March 2012 is 12.4 million km^2 and is estimated to be between 10.9 and 13.9 million km^2.

The model fitted appears to be reasonably good as are the differences between the raw and fitted data in the graph above appear to be very small and my prediction is not far from the given data. There is little variability in the seasonal effects from year to year and the seasonal pattern has stayed fairly constant over the whole time so I can rely on the predictions generated from the Holt-Winters model. However the seasonal effects for September vary much more than other quarters, this is visible in the first graph where the September seasonal effects are much more spread than for other quarters. So I would be less confident in my predictions for that quarter than for other quarters. (3)

(4)

Looking at the graph of the residuals also confirms that the predictions should be fairly reliable as the residuals appear to be small as most are no more than 0.5 million km^2 above or below the line and have limited variability and no obvious pattern. The residual at September 2007 is a bit odd compared to the others as it is nearly 1 million km^2 below the line which is quite a bit more compared to the others, and the residuals seem to vary much more at the end of the graph, which makes me less confident in my predictions for the future.

However these graphs do not take account of that fact that the global temperature is also increasing due to global warming therefore this could impact area of sea ice in the Arctic. The decreasing area of sea ice in the arctic could be a result from global warming where the temperature is increasing globally causing more ice to melt in warmer seasons and less ice forming in the colder seasons in the Arctic. The decreasing area of sea ice in the Arctic could impact the global weather. The reduction of sea ice could result in more area of less reflective sea water being exposed. This causes less solar heat to be reflected back into space and could possibly increase the effects of global warming and could also possibly increase the trend shown in the graph. (5)

In summary my analysis confirms that the amount of Arctic sea ice is decreasing and is likely to decrease in the future. The model that iNZight produces is a reliable one that can be used to make predictions for the near future that are reasonably reliable.