Reading the Sines of the Times

Name: _____

Honors Precalculus - Spring Semester Project
Teacher: James Millikan, S.J.
AMDG

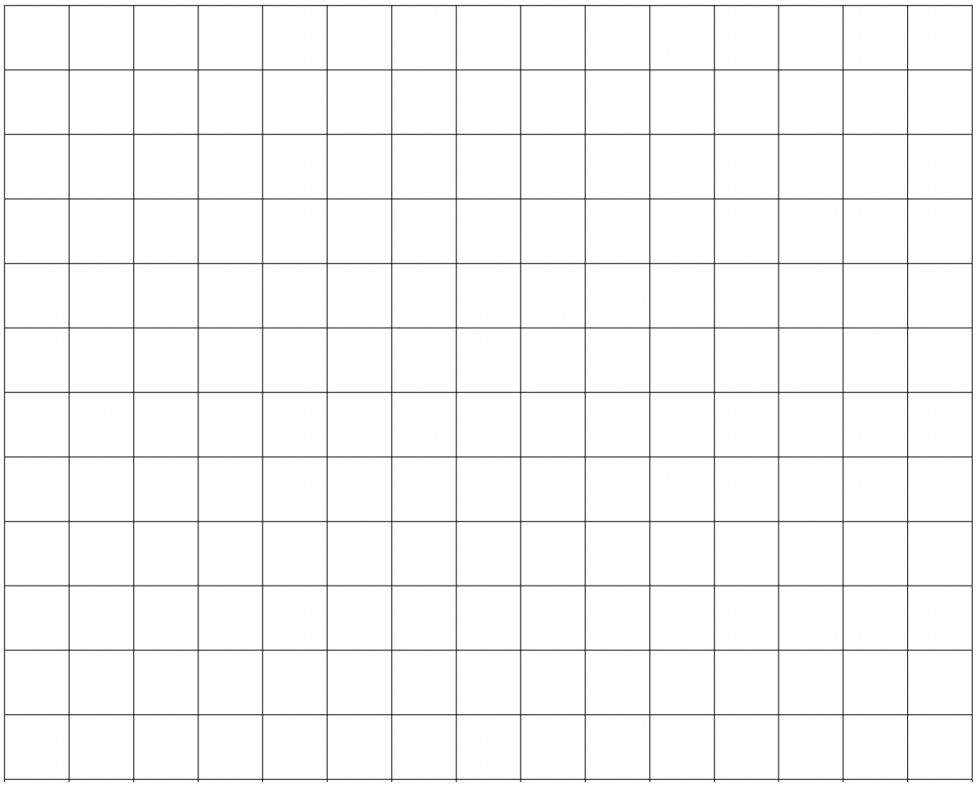
Directions: Respond carefully to each question and thoroughly justify your answers.

The town of Bethel, Alaska has collected careful weather data since the construction of their airport in 1942. The National Oceanic and Atmospheric Administration (noa.gov) gives the following average monthly temperatures (in degrees F) for the 1960s and 2010s.

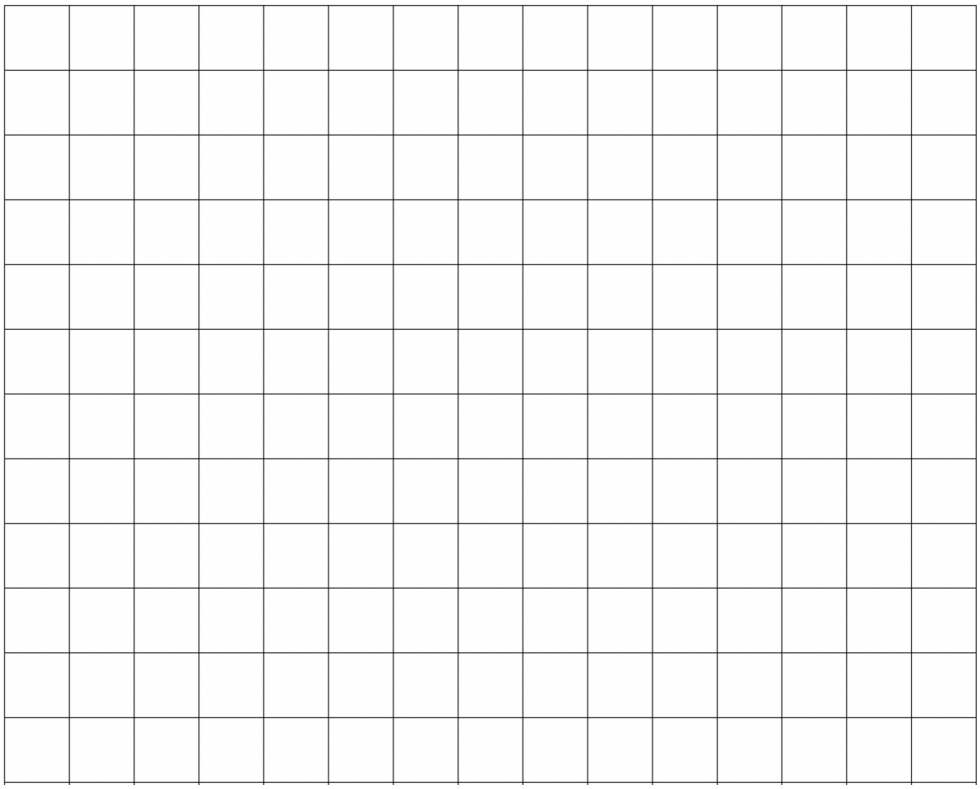
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1960s	7.4	6.6	12.0	22.5	39.0	50.7	54.8	51.5	45.4	28.5	15.8	5.7
2010s	10.0	15.2	14.3	29.6	43.6	53.9	56.1	54.2	46.6	35.0	19.5	12.1

1. Plot these points on the coordinate planes below. Let x=1 represent January 15, x= 2 represent February 15, etc. Be sure to label your axes. (Graphs continue next page).

Average monthly temperatures 1960-1969 in Bethel, AK



Average monthly temperatures 2010-2019 in Bethel, AK



2. From the tables and your graphs, calculate the amplitude, vertical shift, period, and phase shift. Use these values to write sinusoidal functions that model the average temperature in Bethel as a function of time x. Write your functions in the form $y = a\cos(bx + c) + d$. You should have two functions, one for the 1960s and one for the 2010s. Show your work. The relevant formulas are presented below.

Amplitude: $|a|$ Period: $\frac{2\pi}{|b|}$ Frequency: $\frac{|b|}{2\pi}$ Phase shift: $-\frac{c}{|b|}$ Vertical Shift: d

$f(x) =$ _____ $g(x) =$ _____

3. Calculate the average (mean) monthly temperatures in Bethel for the 1960s and for the 2010s. Compare these averages with the values of d in both models. What do these values represent? What do their differences represent? Explain.

4. Use your models to estimate the temperature in Bethel on St. Ignatius Day (July 31) in the 1960s and the 2010s. Make sure to use the correct units and explain what your answer means in the context of this problem.

5. The temperature in Bethel on St. Ignatius Day in 2018 (the summer Br. James was there!) was 56.0° F. Using the appropriate model, calculate the **residual**, that is, the actual temperature minus the temperature predicted by the model. Explain what this means in the context of the problem.

Reflection

6. In the encyclical *Laudato Si*, Pope Francis writes that "Climate change is a global problem with grave implications: environmental, social, economic, political and for the distribution of goods. It represents one of the principal challenges facing humanity in our day." (LS, no. 25). What negative implications might be associated with warming temperatures in Alaska? In your answer, refer to your responses from question 3.

7. Pope Francis also notes, "Humanity is called to recognize the need for changes of lifestyle, production and consumption, in order to combat this warming or at least the human causes which produce or aggravate it" (LS, no. 23). How might your lifestyle, production, and consumption be contributing to global warming? What changes could you make to live more simply?

8. Use this space to reflect upon what you learned by completing this project. Then list at least two questions you would like to explore in the future.