Worksheet 4: Sample Application Problem -- CO_2 model

The tables at left show annual average CO_2 concentrations by year, and listed as terms of a sequence. A graph shows that the data points are approximately arranged in a straight line, and computing the differences for the data we see that they are all in a range between 1.7 and 2.7. For both of these reasons, it is reasonable to develop an arithmetic growth model for this situation. This outline will show what that involves.

Year	Carbon Dioxide Concentration
2006	381.90
2007	383.76
2008	385.59
2009	387.37
2010	389.85
2011	391.63
2012	393.82
2013	396.48

Carbon dioxide concentration in parts per million.

Data Table	
n	a_n
0	381.9
1	383.76
2	385.59
3	387.37
4	389.85
5	391.63
6	393.82
7	396.48

Data in form of a sequence

1. Defining variables. We want to model this number sequence: 381.9, 383.76, 385.59, etc. To use our difference equation methods, we need to use variables like n and c_n . For future reference, and to provide a clear explanation for anyone examining our work, we have to give precise explanations of what these variables stand for. Fill in the blanks below, specifying units of measurement as appropriate:

   Variable n represents _____, starting with $n = 0$ for _____.

   Variable c_n represents _____.

2. Choose parameters for the model, so the arithmetic growth sequence c_n comes as close as possible to the data points. We will use the Arithmetic Growth excel spreadsheet in class for this. Record below the parameters we find, and the average error for our model.

3. Record the difference and functional equations for c_n.

PROBLEM CONTINUES ON THE OTHER SIDE

4. Use the model to predict CO_2 levels for the years 2020 and 2050. Use the functional and/or difference equations. Check your answers by looking at the graph.

5. Use the model to predict when the CO_2 level will reach 500. Use a numerical trial and error approach with the functional equation, and also algebra, and also check the graph.

6. An important part of developing and using a model is to reflect on your results, as described in the text. We'll discuss this briefly as a class. Record below any points from that discussion that you think are important.