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CP.4.2.7, Sauer3

The file `windmill.txt`, available from the textbook website, is a list of 60 numbers which represent the monthly megawatt-hours generated from Jan. 2005 to Dec. 2009 by a wind turbine owned by Minnkota Power Cooperative near Valley City, ND. The data is currently available at `http:www.minnkota.com`. For reference, a typical home uses around 1MWh per month.

a. Find a rough model of power output as a yearly periodic function. Fit the data to equation (4.9),

$$f(t) = c_1 + c_2 \cos 2\pi t + c_3 \sin 2\pi t + c_4 \cos 4\pi t$$

where the units of t are years, that is $0 \le t \le 5$, and write down the resulting function.

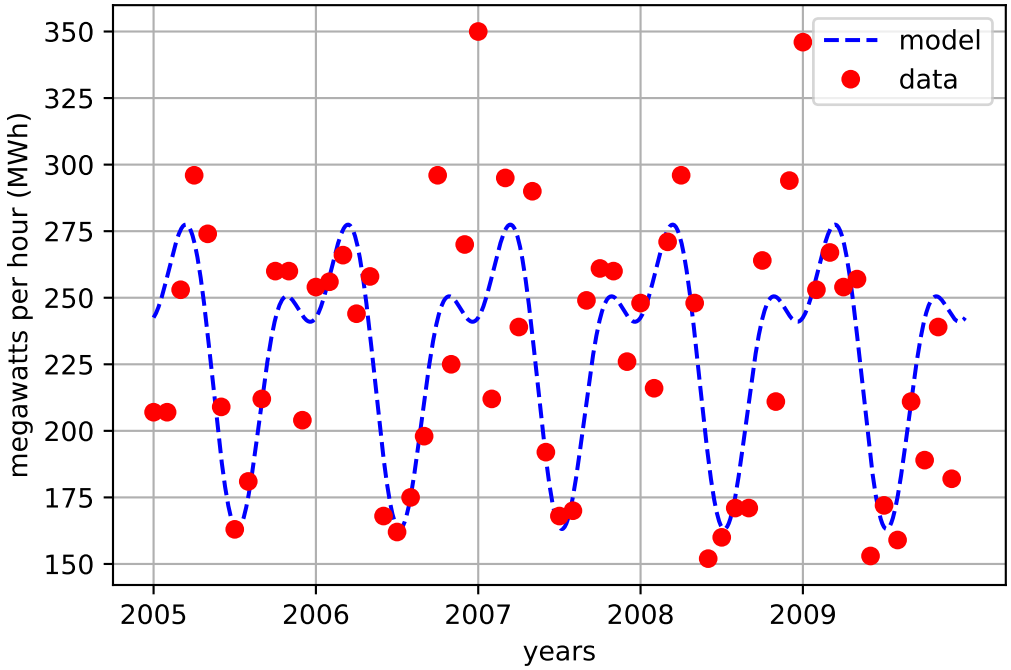
b. Plot the data and the model function for years $0 \le t \le 5$. What features of the data are captured by the model?

Do not worry about the questions of Sauer. This problem is (more or less) solved in the following notebook. You have 4 handwritten questions to answer next page.

	2005	2006	2007	2008	2009
Jan.	207	254	350	248	346
Feb.	207	256	212	216	253
Mar.	253	266	295	271	267
Apr.	296	244	239	296	254
May	274	258	290	248	257
Jun.	209	168	192	152	153
Jul.	163	162	168	160	172
Aug.	181	175	170	171	159
Sep.	212	198	249	171	211
Oct.	260	296	261	264	189
Nov.	260	225	260	211	239
Dec.	204	270	226	294	182

Production in megawatt-hours generated from Jan. 2005 to Dec. 2009.

Jupyter Notebook: https://colab.research.google.com/drive/1DJFK_hsx23JiX1GF4BFuaNKCtLG7FoeO



Handwritten questions:

a. In the code what does the array `t` represent?

b. Explain what these lines do:

```
A = np.zeros( [ 60, 4] )
A[:,0] = np.ones( 60)
A[:,1] = np.cos(2*pi*t)
A[:,2] = np.sin(2*pi*t)
A[:,3] = np.cos(4*pi*t)
```

Note: Writing "this creates the matrix A" is not enough. Something like "this creates the matrix A such as the first column is ... and the second column is ..., each row represents ..." is needed

c. We find that the model is

$$f(t) = 229.9 + 39.3\cos 2\pi t + 14.5\sin 2\pi t - 26.7\cos 4\pi t$$

What is $f(t)$? What is t? Which month does $t = 1$ represent? What is the value of t that represents the month of April 2007?

d. Do you think we have a good fit? Is this a good model?