Escola de Engenharia de Minas Gerais
Ciência da Computação
Calculo II

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Aplicação Algoritmo da Regra de Simpson para Cálculo de Integral

https://en.wikipedia.org/wiki/Simpson%27s_rule

https://mathworld.wolfram.com/SimpsonsRule.html

https://personal.math.ubc.ca/~CLP/CLP2/clp_2_ic/sec_Simpson.html

https://www.freecodecamp.org/news/simpsons-rule/

https://pythonnumericalmethods.berkeley.edu/notebooks/chapter21.04-Simpsons-Rule.html

Books

Numerical Recipes in C book set: Numerical Recipes in C: The Art of Scientific Computing, Second Edition

Numerical Analysis

918 Pages · 2015 · 129.87 MB · English
by Annette M. Burden & J. Douglas Faires & Richard L. Burden
numerical analysis introduction to linear algebra for science and engineering numerical methods books

In South Australia, as in most other states, if one installs photovoltaic cells on one's roo to generate electricity, there is a feed-in tariff operable. What does this mean? When yo supply electricity to the grid, you get $50c$ per kWh and when you take electricity fron the grid you pay $18c$ per kWh. What we are going to do is to estimate this activity fo one day to see how much more you get from the feed-in tariff than you have to pay fo electricity. To give this in more detail, if you are generating more than you are using ir the house, the extra is sent to the grid and you get the feed-in tariff for that extra amount When your load is more than you are generating, the extra amount you get from the gric is paid for with the normal tariff.

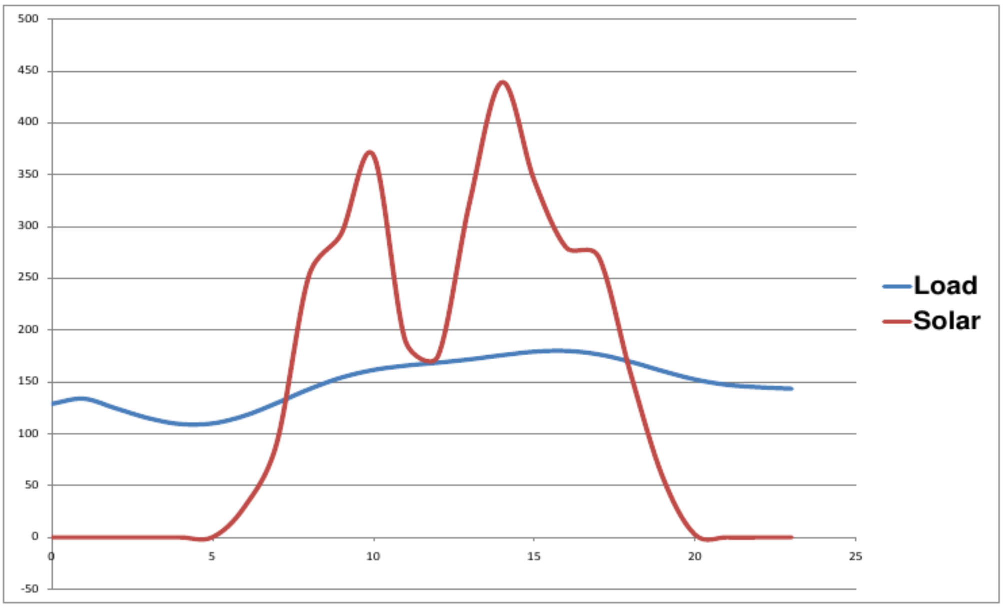

Figure 2: Electricity Demand and Solar Supply

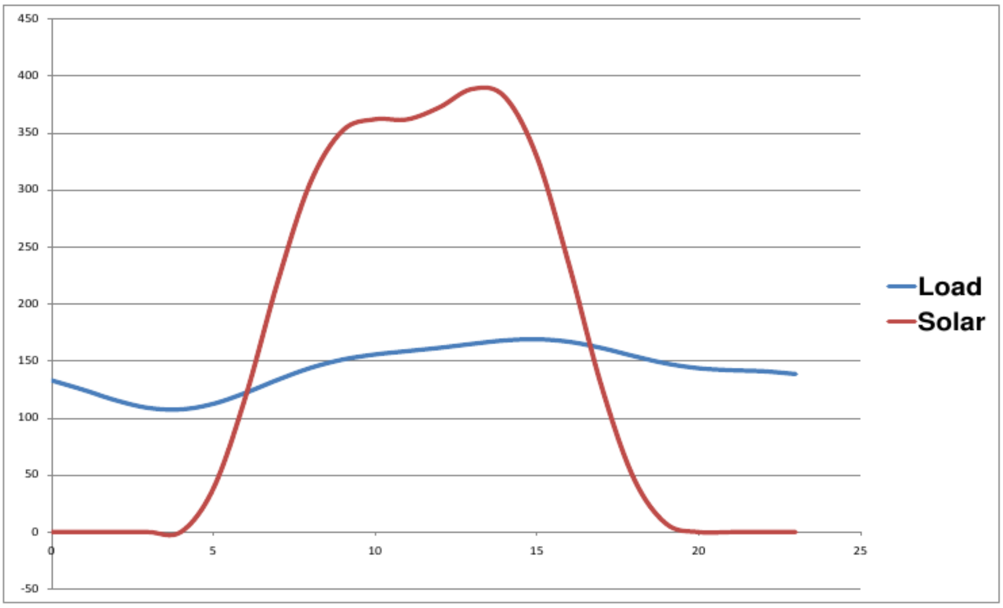

Figure 3: Smoothed Load and Solar Supply

- The **Simpson's Rule** approximation to $\int_a^b f(x)dx$ with $\Delta x = \frac{b-a}{2n}$ is given by

Time	Load	Solar
0	128.67	0.00
1	133.65	0.00
2	124.40	0.00
3	115.03	0.00
4	109.22	0.00
5	109.78	0.00
6	117.20	29.29
7	129.38	90.34
8	142.73	252.00
9	153.92	292.27
10	161.33	369.14
11	165.52	189.42
12	168.37	173.83
13	171.61	323.57
14	175.59	439.09
15	179.00	344.66
16	179.76	279.28
17	176.43	270.96
18	169.26	157.72
19	160.28	57.73
20	152.23	2.50
21	147.04	0.00
22	144.69	0.00
23	143.30	0.00

Figure 4: Load and Supply Data

$$S_{2n} = \frac{\Delta x}{3}\left(f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + 2f(x_4) + \ldots + 2f(x_{2n-2}) + 4f(x_{2n-1}) + f(x_{2n}\right.$$

Use Simpson's Rule to find an approximation to the difference in load and supply as given in the table and represented in Figure 2. Note you will be finding the difference in three separate regions since for the first part of the day, the load is greater than supply, the opposite in the middle of the day and back to load greater than supply at the end. Do this approximation in two ways, first with $\Delta x = 2$ hours and then with $\Delta x = 1$ hour. Comment on which you think is more accurate. Calculate your profit.

Hint: Implement Simpson's Rule in Matlab or Excel.

- Figure 3 gives a smoothed version of both load and supply. Use integration methods to calculate the difference in load and supply and then calculate your profit. The functional forms for load $L(t)$ and supply $S(t)$ are given below, but for the solar assume that for $t < 5$ and $t > 18$, $S(t) = 0$.:

$$\begin{aligned} L(t) = 142.8 \quad &- \quad 19.39cos(2\pi t/24) - 17.03sin(2\pi t/24) \\ &+ \quad 4.56cos(4\pi t/24) - 3.80sin(4\pi t/24) \\ &+ \quad 5.15cos(6\pi t/24) - 0.93sin(6\pi t/24) \end{aligned}$$

$$\begin{aligned} S(t) = 151.7 \quad &- \quad 212.8cos(2\pi t/24) + 31.45sin(2\pi t/24) \\ &+ \quad 57.48cos(4\pi t/24) + 8.61sin(4\pi t/24) \\ &+ \quad 36.5cos(6\pi t/24) - 0.89sin(6\pi t/24) \end{aligned}$$