

Making Yoghurt

Making yoghurt calls for heating milk to 190°F to kill off undesirable bacteria, and then cooling to 110°F. Some pre-made yoghurt with “live culture” is added, and the mixture kept at 110°F for 7-8 hours. This is the ideal temperature for growth of *Lactobacillus*, a useful micro-organism turns milk into yoghurt.

The tables below represent a set of temperature measurements for milk over time in yoghurt preparation where (a) is the heating phase and (b) the cooling phase (data collected in a kitchen). The data is also plotted below with a convenient curve fit.

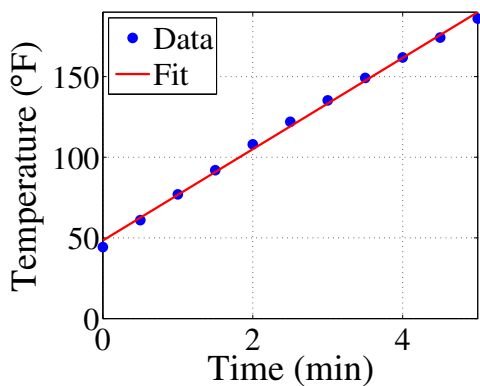
(a) Heating Milk

time (min)	Temperature (°F)
0.0	44.3
0.5	61
1.0	77
1.5	92
2.0	108
2.5	122
3.0	135.3
3.5	149.2
4.0	161.9
4.5	174.2
5.0	186

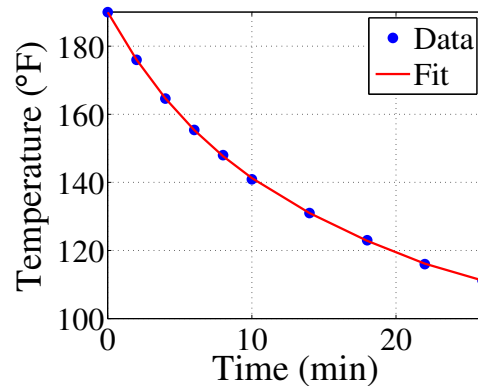
(b) Cooling Milk

time (min)	Temperature (°F)
0	190
2	176
4	164.6
6	155.4
8	148
10	140.9
14	131
18	123
22	116
26	111.2

(a) Heating Milk



(b) Cooling Milk



By taking more frequent temperature measurements, we create a refined data set for milk cooling:

<i>Original</i>		<i>Refined</i>		<i>More refined</i>	
time (min)	Temperature (°F)	time (min)	Temperature (°F)	time (min)	Temperature (°F)
0	190	0	190	0	190
2	176	1	182	0.5	185.5
4	164.6	2	176	1	182
6	155.4	3	169.5	1.5	179.2
8	148	4	164.6	2	176
10	140.9	5	159.8	2.5	172.9

Our goals are to understand the following questions:

1. How “fast” is the temperature $T(t)$ increasing in (a)?
2. How fast is it decreasing in (b)?