# ASE-4046 Exercise Set 3 (Curve fitting)

### Problem 1

In 1875, barometers were heavy and fragile instruments, so James D. Forbes developed a model of atmospheric pressure $v$ (in inches of Hg) as a function of the boiling temperature of water $x$ (in deg F). With this model, mountaineers could measure their altitude with a thermometer and a portable cooking stove. He fitted an exponential model to the data collected by explorers a few years earlier during an expedition in the Himalayas:

| | | | | | | |
|---|---|---|---|---|---|---|
| x | 210.2 | 197 | 191.4 | 185.7 | 183.2 | 181.15 |
| v | 28.559 | 21.892 | 19.758 | 17.267 | 16.385 | 15.919 |

Use the formulas of slide 6 to find the coefficients of the exponential model. Plot the data and the fitted curve on linear and semilog axes (two plots).

### Problem 2

An instrument uses graphite furnace atomic absorption spectroscopy to measure lead concentration in water. In order to calibrate the instrument, you prepare samples of known concentration (in ppb) and record the instrument signal (in A s):

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| conc | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
| signal | 0.006 | 0.077 | 0.138 | 0.199 | 0.253 | 0.309 | 0.356 |

Fit a degree-2 polynomial curve to the data, using *signal* as the independent variable. Plot the curve and data. A sample of tap water from your home gives a reading of 0.278 A s. What is your water's lead concentration?

### Problem 3

Actually, Forbes' original dataset had an error: the explorers wrote the last pressure value as 25.919 instead of 15.919. Fit the exponential model to this erroneous dataset by minimising the sum of absolute residuals of a straight line in semilog space.

**Answers** 1. $v \approx 0.3942\,\mathrm{e}^{0.0204x}$ 2. 44.4 ppb 3. $v \approx 0.4142\mathrm{e}^{0.0201x}$