# Day-Night Cycle Implementation

The day-night cycle in newer versions of MCprep is implemented with quadratic functions. They are:

$$s(x) = -0.131x^2 + 2.959x - 10.946$$

$$m(x) = \begin{cases} 0.056x^2 - 2.152x + 21.487 & \text{if } x \geq 18 \\ -0.036x^2 - 0.079x + 1.557 & \text{if } x \leq 5 \end{cases}$$

# Regression Implementation

MCprep uses a hand written regression algorithm for the following reasons:

- Less magic to developers
- Open, doesn't require owning a TI graphing calculator (which can cost hundreds of dollars)
- Consistency: 5 years from now this should have the same results as today, and not change

The steps MCprep's algorithm takes can be summerized with the following. Given 2 sets of size $n$, one holding $x$ values and one holding $y$ values, we can get a quadratic that closely matches what we want by solving the following system of equations:

$$a \sum x_i^4 + b \sum x_i^3 + c \sum x_i^2 = \sum x_i^2 y_i$$

$$a \sum x_i^3 + b \sum x_i^2 + c \sum x_i = \sum x_i y_i$$

$$a \sum x_i^2 + b \sum x_i + cn = \sum y_i$$