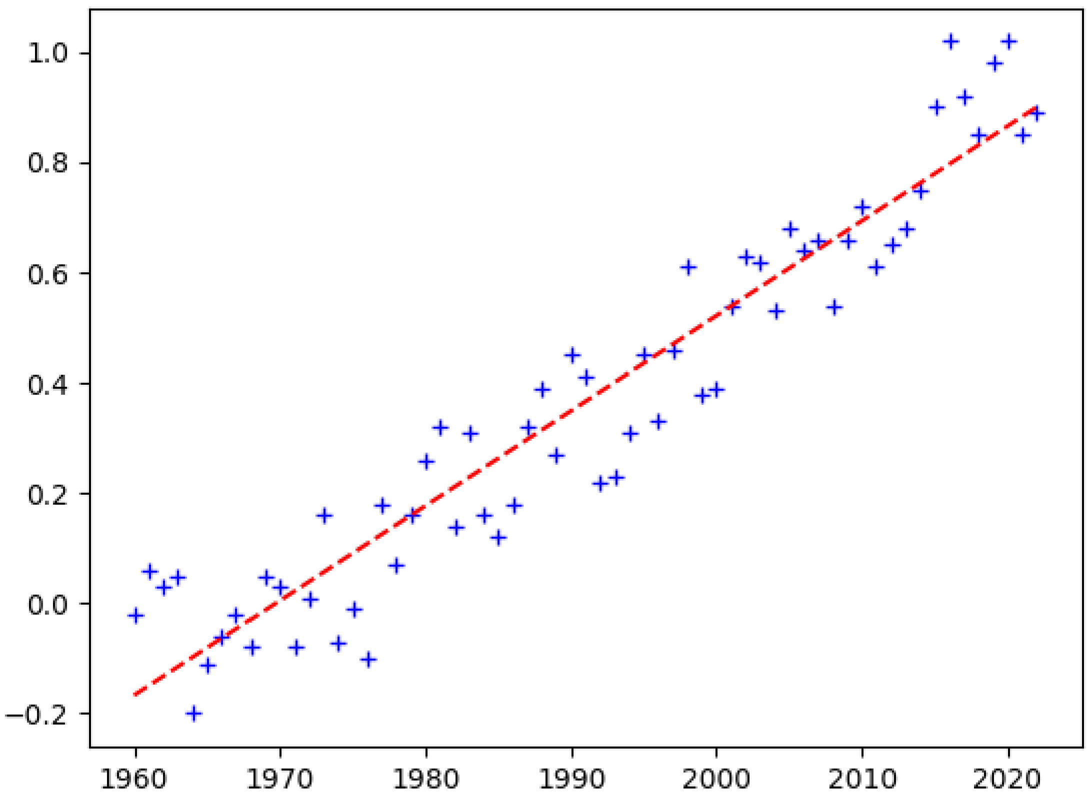
Problem 3.6 and 4.1

Problem 3.6:

ΔT is likely to reach 1.5 in the year 2056

The parameter a represents the amount of temperature the Earth will change by without the effects of time

The parameter b represents the increased amount of temperature the Earth will change by due to the human influences that year



Problem 4.1:

$$\frac{dN}{dt} = R_0 N \exp\left(-R_1 N\right) - \frac{Y}{2}\left(1 + \tanh\left(\frac{N - N_h}{K}\right)\right)$$

Require $R_0 N = \hat{N}$ and $-R_1 N = -\hat{R}_1 \hat{N}$. This implies $N = \frac{1}{R_0}\hat{N}$ and $R_1 = \frac{\hat{R}_1 \hat{N}}{N} = \frac{\hat{R}_1 \hat{N}}{\frac{1}{R_0}\hat{N}} = R_0 \hat{R}_1$. So we have the first two changes of variables, $N = \frac{1}{R_0}\hat{N}$ and $R_1 = R_0 \hat{R}_1$.

Now $\frac{d}{dt}(N) = \frac{d}{dt}(\frac{1}{R_0}\hat{N}) = \frac{1}{R_0}\frac{d\hat{N}}{dt}$. We require that this is equal to $\frac{d\hat{N}}{d\hat{t}}$ so let $t = \frac{1}{R_0}\hat{t}$ to make these equal.

Require $N - N_h = \hat{N} - 1$. Using the substitution from before, $\frac{1}{R_0}\hat{N} - N_h = \hat{N} - 1$. Rearranging for N_h gives $N_h = (\frac{1}{R_0} - 1)\hat{N} + 1$. Finally let $Y = \hat{Y}$ and $K = \hat{K}$.