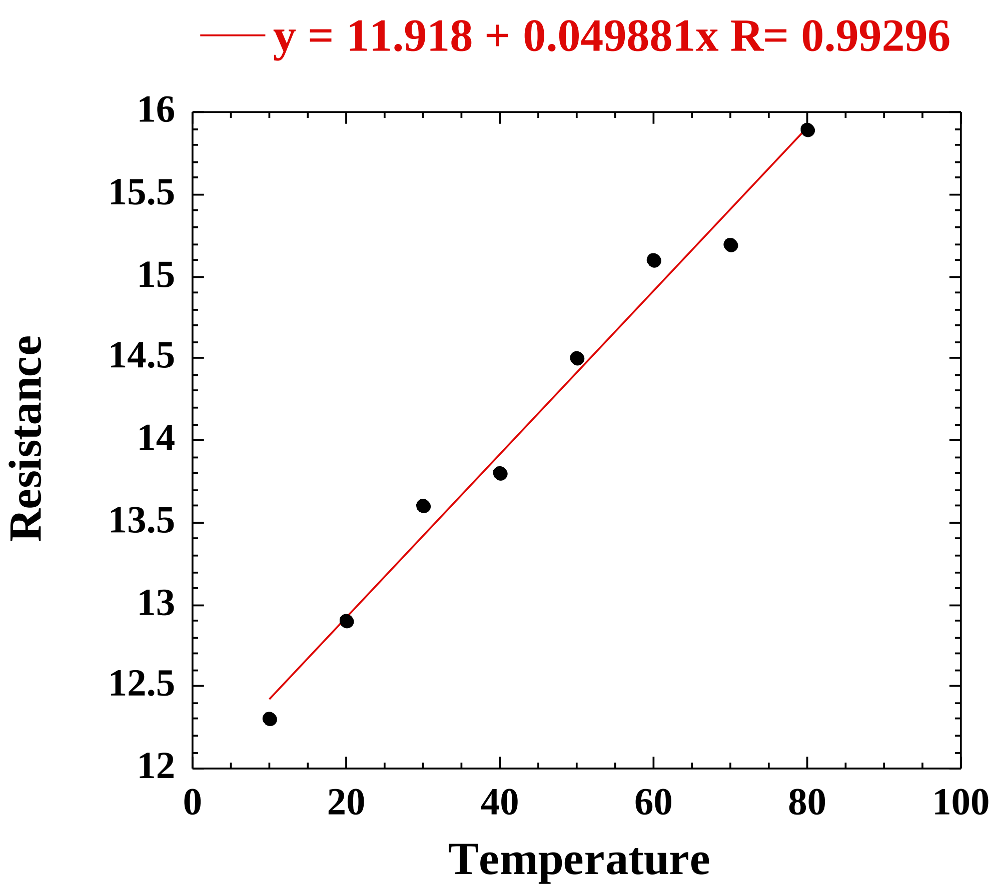
Homework Least Squares

An experiment has been carried out to investigate the temperature dependence of the resistance of a copper wire. A common model is represented by the equation R = Ro (1+alpha T) where R is the resistance at 0 Centigrade, and alpha is the temperature coefficient of resistance. Observations of R and T were obtained as given in the table.



a.) Slope = 0.0499 Ohms/degree C, Intercept 11.92 Ohms

b.) α=m/Ro = (.0499)/(11.92)= 0.00419 /degree C

c.) S_y = 0.15742. So that S_m = 0.15742 $(8/(8*20400- 360^2))^{0.5}$ =0.0024 ohms/degree. For S_b we have $S_b = S_y \sqrt{\frac{\sum x_i^2}{N \sum x_i^2 - \left(\sum x_i\right)^2}}$ = 0.12 Ohms

d.) α=m/Ro so error in α = Sqrt[((partial α /partial m) times S_m)^2 + ((partial α /partial Ro) times S_{Ro})^2]

e.) Ro = b and Ro alpha = m. We have m and b with errors. We want alpha with errors. Note these two equations reduce to m = alpha b or alpha = m/b. This is like z = x y where we know x and y with errors and want to know z with errors. Using differentiation to get the error in alpha we have

$$S_\alpha = \alpha \sqrt{\left(\frac{S_b}{b}\right)^2 + \left(\frac{S_b}{m}\right)^2} = 0.00411 \sqrt{\left(\frac{0.12}{11.92}\right)^2 + \left(\frac{0.0024}{0.049}\right)^2} = 0.00021 \text{deg}^{-1}$$

f.) α=0.00419+/- 0.00021 deg^{-1}, R_o=11.92+/-0.16 Ohm