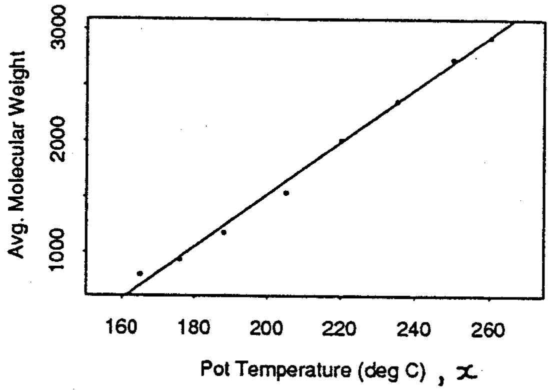
Stat 305 HW #4 Solutions

P140. 3. (a) $R^2 = .994$.

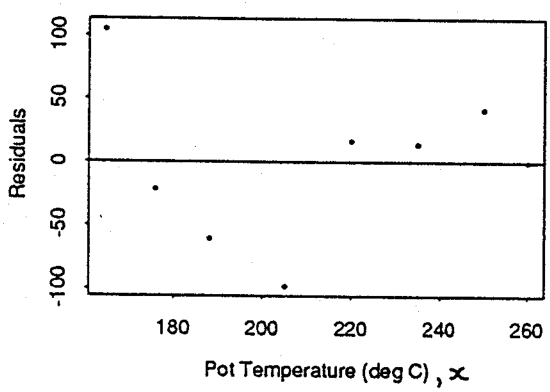
(b) The least squares equation is

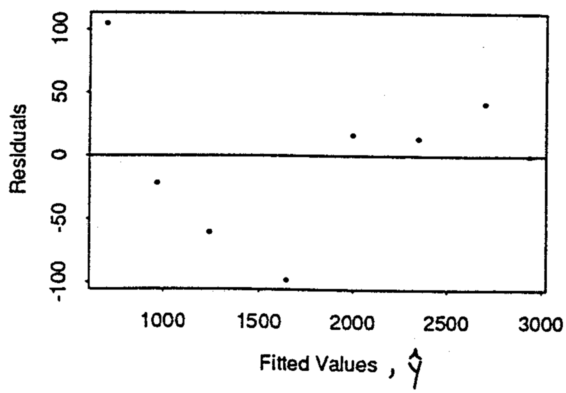
$$\hat{y} = -3174.6 + 23.5x.$$

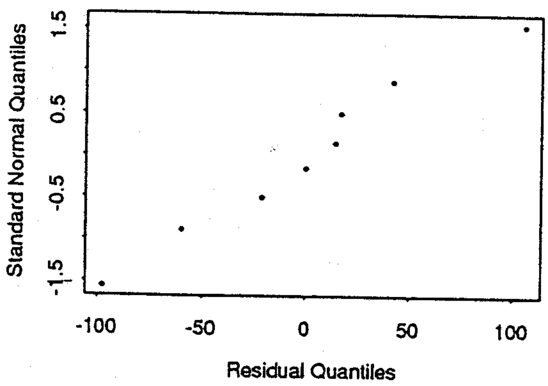
β_1 represents the "true" average change in molecular weight that accompanies a 1°C increase in pot temperature (assuming that a straight-line model is correct). $b_1 = 23.5$ is a data-based approximation of this value.



(c) The residuals are: 105.36, −21.13, −60.11, −97.58, 16.95, 14.48, 42.00, and .02.







It is difficult to evaluate the appropriateness of the fitted equation based on so little data. The plots of residuals versus x and residuals versus $\hat{y}$ do not contain any obvious patterns, and thus provide no evidence that the equation is inappropriate. The normal plot of residuals is fairly linear, providing no evidence that the residuals are not bell-shaped.

(d) There is no replication (multiple experimental runs at a particular pot temperature). Replication would validate any conclusions drawn from the experiment, and provide more information to confirm the appropriateness of the fitted equation.

(e) For $x = 188°\text{C}$,

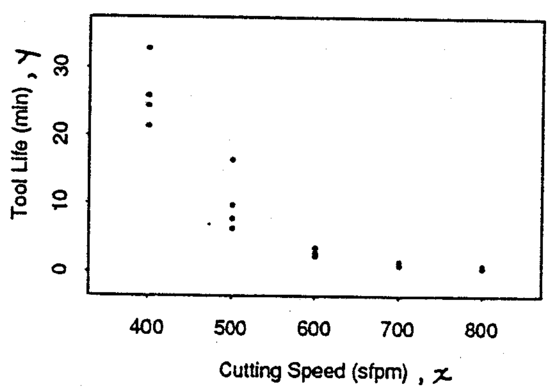
$$\hat{y} = -3174.6 + 23.5(188) = 1243.1.$$

For $x = 200°\text{C}$,

$$\hat{y} = -3174.6 + 23.5(200) = 1525.1.$$

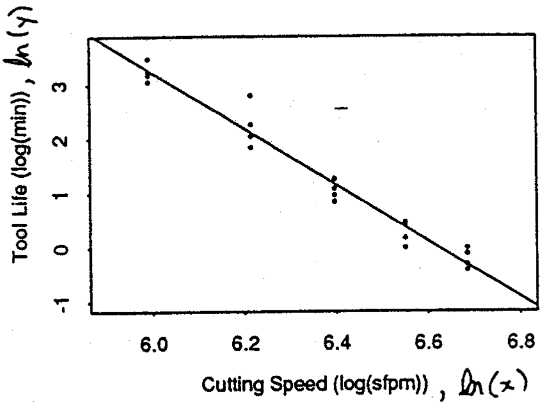
It would not be wise to make a similar prediction at $x = 70°\text{C}$ because there is no evidence that the fitted relationship is correct for pot temperatures as low as $x = 70°\text{C}$. This would be an extrapolation. Some data should be obtained around $x = 70°\text{C}$ before making such a prediction.

P140. 4 (a)



The scatterplot is not linear, so the given straight-line relationship does not seem appropriate. The least squares line is $\hat{y} = 44.075 - .059650x$. The corresponding R^2 is .723.

(b)



This scatterplot is much more linear, and a straight-line relationship seems appropriate for the transformed variables. The least squares line is $\widehat{\ln y} = 34.344 - 5.1857 \ln x$. The corresponding R^2 is .965.

(c) The least squares line is given in part (b). For $x = 550$,

$$\widehat{\ln y} = 34.344 - 5.1857 \ln(550) = 1.6229 \ln(\text{minutes}),$$

so $\hat{y} = e^{1.6229} = 5.07$ minutes. The implied relationship between x and y is

$$\begin{aligned} y &\approx e^{\beta_0 + \beta_1 \ln x} \\ y &\approx e^{\beta_0} e^{\ln x^{\beta_1}} \\ y &\approx e^{\beta_0} x^{\beta_1}. \end{aligned}$$

With slight rearrangement, this is the same as Taylor's equation for tool life.