Residual example

The table below gives data on height (in inches) and hand span (in centimeters) for 23 students enrolled in Math 160. For the height data distribution, the mean is $\bar{x} = 68.04$ inches and the standard deviation is $s_x = 3.019$ inches. For the hand span data distribution, the mean is $\bar{y} = 20.27$ cm and the standard deviation is $s_y = 2.144$ cm. The correlation for these variables is $r = 0.746$. Based on these, we can calculate the slope and intercept of the least-squares regression line to get the formula

$$\hat{y} = -15.78 \text{ cm} + (0.5297 \text{ cm/in})x.$$

Using this, we can calculate a *predicted* hand span for each value of height. For example, for $x_1 = 66.0$ in, we have the predicted hand span of

$$\hat{y}_1 = -15.78 \text{ cm} + (0.5297 \text{ cm/in})(66.0 \text{ in}) = 19.1802 \text{ cm}$$

The corresponding *residual* is computed as the difference between the *observed* value and the *predicted* value. For the first data point, we have

$$\text{residual} = y_1 - \hat{y}_1 = 20.0 - 19.18 = 0.82.$$

The table below shows predicted values and residuals for all of the data. A *residual plot* is also shown below.

Height x	Hand span y	Predicted $\hat{y}$	Residual $\hat{y} - y$
66.0	20.0	19.18	0.82
69.0	21.1	20.77	0.33
69.0	17.6	20.77	-3.17
61.5	16.5	16.80	-0.30
63.0	17.5	17.59	-0.09
68.0	19.0	20.24	-1.24
67.5	20.8	19.97	0.83
71.0	22.5	21.83	0.67
73.0	25.0	22.89	2.11
69.0	23.0	20.77	2.23
72.0	20.2	22.36	-2.16
71.0	21.1	21.83	-0.72
66.0	20.7	19.18	1.52
66.0	16.0	19.18	-3.18
66.0	20.3	19.18	1.12
70.0	21.2	21.30	-0.10
69.0	20.0	20.77	-0.77
70.0	22.1	21.30	0.80
72.0	21.9	22.36	-0.46
63.0	17.5	17.59	-0.09
69.0	21.0	20.77	0.23
66.0	20.2	19.18	1.02
68.0	20.9	20.24	0.66