5.17. (a) The slope (1.507) says that, on the average, BOD rises (falls) by 1.507 mg/L for every 1 mg/L increase (decrease) in TOC. (b) When TOC = 0 mg/L, the predicted BOD level is -55.43 mg/L. This must arise from extrapolation; the data used to find this regression formula must not have included values of TOC near 0.

5.18. (a) The slope and intercept are
\[ b = r \cdot s_y/s_x = 0.6337 \cdot 2.10/13.17 \approx 0.1010 \]
\[ a = \bar{y} - b\bar{x} = 7.447 - (0.1010)(108.9) \approx -3.557. \]
The regression equation is \( \hat{y} = -3.557 + 0.1010x \). (b) The straight-line relationship explains \( r^2 = 40.16\% \) of the variation in GPAs. (c) For an IQ of 103, the predicted GPA is \( \hat{y} = 6.85 \); the residual is -6.32.

5.19. (a) At right. (b) The regression equation is \( \hat{y} = 71.950 + 0.38333x \) cm. (c) When \( x = 40 \) months, we predict \( \hat{y} = 87.28 \) cm; when \( x = 60 \) months, \( \hat{y} = 94.95 \) cm. (d) A change of 6 cm in 12 months is 0.5 cm/month (0.5 = \( \frac{6}{12} \)). Sarah is growing at about 0.38 cm/month—more slowly than normal.

5.21. When \( x = 480 \) months, \( \hat{y} = 255.95 \) cm, or 100.77 inches, or about 8.4 feet! Extrapolation is the issue here.

5.25. (a) \( r \) is negative because the association is negative: Countries with high wine consumption have fewer heart disease deaths, while low wine consumption tends to go with more deaths from heart disease. The straight-line relationship explains about \( r^2 = 0.711 = 71.1\% \) of the variation in heart-disease death rates. (b) When \( x = 4 \) liters of alcohol per year, we predict \( \hat{y} = 168.8 \) deaths per hundred thousand people. (c) \( r \) (the correlation) and \( b \) (the slope) must have the same sign because \( b = r \cdot s_y/s_x \), and \( s_y \) and \( s_x \) are positive.

5.27. When \( x = 150 \), we predict \( \hat{y} = -3184.9 \) deaths per 100,000. This is clearly nonsense; people will not suddenly begin to rise from the dead if alcohol consumption goes up (although someone drinking that much alcohol might see people rising from the dead). The data on which we based this regression line had \( x \) between 0 and 10, so we cannot rely on this regression line for predictions outside of that range.