12.6 a) $\hat{\beta}_1 = \frac{9(40.968)-(12.6)(27.68)}{9(18.24)-(12.6)^2} = 3.693$
$\hat{\beta}_0 = \frac{27.68-3.693(12.6)}{9} = -2.095$

b) $\hat{y} = -2.095 + 3.693(1.5) = 3.44$

c) $\hat{\mu}_{Y\cdot 1.75} = -2.095 + 3.693(1.75) = 4.37$

d) residual= $y_i - \hat{y_i} = 3.39 - 3.44 = -0.05$

12.10 a) $\hat{\beta}_0 = .3651, \hat{\beta}_1 = .9668$

b) .8485

c) $\hat{\sigma} = .1932$

d) SST $= 1.4533, 71.7\%$ of this variation can be explained by the model.
Note: $\frac{\text{SSR}}{\text{SST}} = \frac{1.0427}{1.4533} = .717$ which matches R-squared on output.

12.12 a) SSE= $93.3448 - (-2.095)(27.68) - (3.683)(40.968) = 0.0290$

b) $\hat{\sigma}^2 = \frac{\text{SSE}}{n-2} = .004142, \quad \hat{\sigma} = s = \sqrt{.004142} = .06436$

c) SST=$93.3448 - \frac{(27.68)^2}{9} = 8.213$, so
$r^2 = 1 - \frac{\text{SSE}}{\text{SST}} = 1 - \frac{.0290}{8.213} = .996$. Thus 99.6% of observed y variation can be attributed to the approximate linear relationship between x and y.

12.16 a) Plot omitted. Based on a scatterplot of the data, a linear relationship does seem reasonable for this data.

b) $n = 6, \quad \sum x_i = 272, \sum y_i = 3360, \sum x_i^2 = 18,538, \sum y_i^2 = 2,425,394, \sum x_i y_i = 210,120$, so $\hat{\beta}_1 = 9.312, \hat{\beta}_0 = 137.9$. The estimated equation is $y = 137.9 + 9.312x$.

c) SSE=5585.4, SST=543,794, and $r^2 = 1 - .010 = .990$.

d) The new $\hat{\beta}_1 = 7.5515$ and $\hat{\beta}_0 = 190.35$.

x	14	18	40	43	45	112
y_b	268	305	510	538	557	1181
y_d	296	326	492	515	530	1036

This suggests that the observation (112,1200) is very influential.

12.25 a) $H_0 : \beta_1 = 0$
$H_a : \beta_1 \neq 0$
RR:$|t| > t_{\alpha/2,n-2} = 3.106$
$t = 5.29$
so reject H_0, the slope differs significantly from 0, and the model appears to be useful.

b) At the level $\alpha = 0.01$ reject H_0 if the P-value is less than 0.01. In this case reported P-value was 0.000, therefore reject H_0. Conclusion same as part a.

c) $H_0 : \beta_1 = 1.5$
$H_a : \beta_1 < 1.5$
RR:$t < -t_{\alpha,n-2} = -2.718$
$t = -2.92$
so reject H_0. The data contradicts the prior belief.

12.26 a) $\hat{\beta}_1 \pm t_{\alpha/2,n-2} \cdot s_{\hat{\beta}_1}$
$0.5549 \pm (2.306)(0.3101)$
$(-0.16, 1.27)$
The interval contains the value 0, indicating 0 is a possible value for β_1, and showing little usefulness of the model.

b) The P-value associated with the model is 0.11, which exceeds standard levels of α. This indicates least squares is not a good way to predict age from transparent dentive content.

12.50 $H_0 : \rho = 0$ vesus $H_a : \rho \neq 0$, $t = \frac{r\sqrt{n-2}}{sqrt 1-r^2}$.
RR:$|r| \geq t_{.005,22} = 2.819$
$r = .5778$, $t = 3.32$. So H_0 should be rejected. There appears to be a non-zero correlation in the population.

12.52 a) $H_0 : \rho = 0$ vesus $H_a : \rho \neq 0$, $t = \frac{r\sqrt{n-2}}{sqrt 1-r^2}$.
RR:$|r| \geq t_{.025,12} = 2.179$
$t = 1.74$, failed to reject H_0. the data does not suggest that the population correlation coefficient differs from 0.

b) $(.449)^2 = 0.20$ so 20 persent of the observed variation ingas porosity can be accounted for by variation in hydrogen content.

12.56 a) Because P-value=.00032< $\alpha = .001$, H_0 should be rejected at this significance level.

b) Not necessarily. For this n, the test statistic t has approximately a standard normal distribution when $H_0 : \rho = 0$ is true, and a P-value of .00032 corresponds to $z = 3.60$. Solving $3.60 = r\sqrt{498}/\sqrt{1-r^2}$ for r yields $r = .159$. This r suggest only a weak linear relationship between x and y, one that would typically have little practical import.

13.16 a) $\sum x_i = 9.72, \sum y_i' = 313.10, \sum x_i^2 = 8.0976, \sum y_i'^2 = 8182.8, \sum x_i y_i' = 255.11$ where $y_i' = ln(y_i)$. So $\hat{\beta} = \hat{beta}_1 = 6.667$ and $\hat{\alpha} = e^{\hat{\beta}_0} = e^{20.6917} = 968927163$.

b) We first predict y' using the linear model and then exponentiate. $\hat{y} = 1.438E11$.

c) We first compute a prediction interval for the transformed data and then exponentiate.

With $t_{0.025,10} = 2.228, s = .5946,$ and $\left[1 + \frac{1}{12} + \frac{12(.95-\bar{x})^2}{12\sum x^2 - (\sum x)^2}\right]^{1/2} = 1.082$, the prediction interval for y' is $27.0251 \pm (2.228)(.5946)(1.082) = 27.0251 \pm 1.4334 = (25.5917, 28.4585)$. The P.I. for y is then $e^{25.5917}, e^{28.4585}$).

13.18 a) $Y = \beta_0 + \beta_1 \mathtt{ln}(x) + \varepsilon$ where x =concentration and y =critical minimum pH. With $x' = \mathtt{ln}(x)$ we can find $\hat{\beta_1} = .483$ and $\hat{\beta_0} = 7.29$.

b) the P.I is $7.29 \pm (4.303)(.6496)(1.360) = (6.91, 7.67)$.

13.22 a) the model is $\frac{1}{y} = \alpha + \beta x + \varepsilon$.

b) the model is $\mathtt{ln}\left(\frac{1}{y} - 1\right) = \alpha + \beta x + \varepsilon$ or $Y = \frac{1}{1+e^{\alpha+\beta x+\varepsilon}}$.

c) the model is $\mathtt{lnln}Y = \alpha + \beta x + \varepsilon$ or $Y = e^{e^{\alpha+\beta x+\varepsilon}}$.

d) This function cannot be linearized.