12.11

a). β_1 = expected change for a one degree increase $= -0.01$, and $10\beta_1 = -0.1$ is the expected change for a 10 degree increase.

c). The probability that the any observation (for a temperature of 250) is between 2.4 and 2.6 is

$$\begin{aligned} P(2.4 &\leq Y \leq 2.6) = P(\frac{2.4-2.5}{0.075} \leq Z \leq \frac{2.6-2.5}{0.075}) \\ &= P(-1.33 \leq Z \leq 1.33) = 0.8164 \end{aligned}$$

So the probability that all five are between 2.4 and 2.6 is $(0.8164)^5 = 0.3627$.

d). Let Y_1 and Y_2 denote the times at the higher and lower temperatures, respectively. Then $Y_1 - Y_2$ is distributed as normal with mean $5.00 - .01(x+1) - (5.00 - .01x) = -.01$ and standard deviation $\sqrt{2 \times (.075)^2} = .10607$.Thus

$$P(Y_1 - Y_2 > 0) = P(Z > \frac{0-(-0.1)}{.10607}) = .4641$$

12.26 Show that the "point of averages" $(\overline{x}, \overline{y})$ lies on the estimated regression line.

Proof: Check wether $(\overline{x}, \overline{y})$ satisfies the esimated regression line:

$$y = \widehat{\beta}_0 + \widehat{\beta}_1 x$$

using the expressiones (12.2) and (12.3) for $\widehat{\beta}_0$ and $\widehat{\beta}_1$.

12.31

a). $\widehat{\beta}_1 = -0.00736023 \quad \widehat{\beta}_0 = 1.41122185$

s^2 =SSE/13 $= .04925/13$=.003788

The estimated variance of $\widehat{\beta}_1$ is

$$\widehat{\sigma}^2_{\widehat{\beta}_1} = \frac{s^2}{\sum(x_i - \overline{x})^2} = \frac{.003788}{3662.25} = 0.00000103$$

So the estimated s.d. is 0.001017.

b). $-0.00736 \pm (2.160)(0.001017) = (-.00956, -.00516)$.

12.37

a). $\widehat{\beta}_1 = .00680058, \quad \widehat{\beta}_0 = 2.14164770,$

$\widehat{\sigma} = .110, \quad \widehat{\sigma}_{\widehat{\beta}_1} = .000262$

b). We wish to test

$$H_0: \ \beta_1 = 0.006 \quad H_a: \ \beta_1 \neq 0.006$$

The test statistic is equal to

$$t = \frac{0.0068 - 0.0060}{.000262} = 3.06$$

Since $t_{.01,8} = 2.896$, the P-value for t=3.06 is smaller than 2%, so H_0 is rejected at significant level 10%.