**2.** $\hat{y} = 102.708 - .833\,\text{PROTEIN} - 4.000\,\text{ANTIBIO} - 1.375\,\text{SUPPLEM}$

Each 1% increase of protein in the steer feed is, on average, associated with a decrease of .833 days in feedlot time required to bring a steer to market weight, when the percentages of antibiotic and supplement are held constant.

The interpretations for $\hat{\beta}_2$ and $\hat{\beta}_3$ are similar.

**3.** $\hat{y}_3 = \hat{\beta}_0 + \hat{\beta}_1 x_{31} + \hat{\beta}_2 x_{32} + \hat{\beta}_3 x_{33} = 102.708 - .833 \times 10 - 4 \times 1 - 1.375 \times 7 = 80.753$

$e_3 = y_3 - \hat{y}_3 = 81 - 80.753 = .247$

**4.** $s_\varepsilon = 1.71$

About 68% of the residuals are within the interval $\pm 1.71$, about 95% of the residuals are within the interval $\pm(2 \times 1.71)$, and almost all (99.7%) of the residuals are within the interval $\pm(3 \times 1.71)$.

**5.** $\hat{\beta}_1 \pm t(n-k-1)_{\alpha/2} SE_{\hat{\beta}_1} = -.833 \pm 2.145(.0987) = (-1.045, -.621)$

We are 95% confident that each 1% increase of protein in the steer feed is associated with a decrease in feedlot time that is between .621 days and 1.045 days, percentages of antibiotic and supplement being equal.

**6.** $H_0 : \beta_2 = 0$ vs. $H_a : \beta_2 \neq 0$

$t = -4.96$ and $p$-value=0.000

We reject the null hypothesis and conclude that ANTIBIO provides statistically significant predictive value when PROTEIN and SUPPLEM are already in the model.

**7.** $H_0 : \beta_1 = \beta_2 = \beta_3 = 0$ vs. $H_a$ : At lease one $\beta_j \neq 0 (j = 1, 2, 3)$

$F = 42.32$ and $p$-value=0.000

We reject $H_0$ and conclude that the three predictors together have statistically significant predictive value.

**8.** $R^2 = 90.1\%$

About 90.1% of the variability in feedlot time is explained by a linear regression model on PROTEIN, ANTIBIO and SUPPLEM.

**9.** $SSR(x_2 \mid x_1) = 72$, this measures the additional variability in the feedlot time that is explained by adding ANTIBIO into the model, given that PROTEIN is already in the model.

$SSR(x_3 \mid x_1, x_2) = 90.75$, this measures the additional variability in feedlot time that is accounted for by adding SUPPLEM into the model, given that PROTEIN and ANTIBIO are already in the model.

**10.** $H_0 : \beta_2 = \beta_3 = 0$ vs. $H_a$ : At least one of $\beta_2, \beta_3 \neq 0$

(The corresponding complete model is: $E\,y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$, and the reduced model is: $E\,y = \beta_0 + \beta_1 x_1$ .)

$F = \frac{SSR(x_2, x_3 | x_1)/2}{SSE(x_1, x_2, x_3)/(n-k-1)} = \frac{(72+90.75)/2}{40.92/14} = 27.84$

$p$-value $= P\{F(2,14) \geq 27.84\} \approx 0 \Rightarrow$ reject $H_0$

Or: $F(2,14)_{.05} = 3.7389$ since $27.84 > 3.7389 \Rightarrow$ reject $H_0$

We conclude that adding ANTIBIO and SUPPLEM does provide additional predictive value, given that PROTEIN is already in the model.