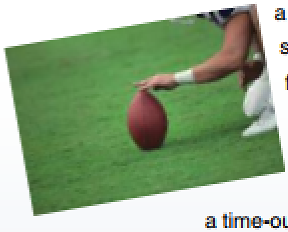
Icing the Kicker

Just as a kicker in football is about to attempt a field goal, it is a common strategy for the opposing coach to call a time-out to "ice" the kicker. The theory is that the kicker has time to think and become nervous and less confident, but does the practice actually work? In "The Cold-Foot Effect" by Scott M. Berry in *Chance* magazine, the author wrote about his statistical analysis of results from two NFL seasons. He uses a logistic regression model with variables such as wind, clouds, precipitation, temperature, the pressure of making the kick, and whether a time-out was called prior to the kick. He writes that "the conclusion from the model is that icing the kicker works—it is likely icing the kicker reduces the probability of a successful kick."



Solution

Using the methods of this section and computer software, we get this regression equation:

$$\text{Height of Child} = 25.6 + 0.377\,(\text{Height of Mother}) + 0.195\,(\text{Height of Father}) + 4.15\,(\text{Sex})$$

where the value of the dummy variable of sex is either 0 for a daughter or 1 for a son.

a. To find the predicted height of a *daughter*, we substitute 0 for the sex variable, and we also substitute 63 in. for the mother's height and 69 in. for the father's height. The result is a predicted height of 62.8 in. for a daughter.

b. To find the predicted height of a *son*, we substitute 1 for the sex variable, and we also substitute 63 in. for the mother's height and 69 in. for the father's height. The result is a predicted height of 67.0 in. for a son.

The coefficient of 4.15 in the regression equation shows that when given the height of a mother and the height of a father, a son will have a predicted height that is 4.15 in. more than the height of a daughter.

Logistic Regression In Example 3, we could use the methods of this section because the dummy variable of sex is a *predictor* variable. If the dummy variable is the response (y) variable, we cannot use the methods of this section, and we should use a different method known as **logistic regression.** Example 4 illustrates the method of logistic regression.

Example 4 Logistic Regression

Let a sample data set consist of the heights, weights, waist sizes, and pulse rates of women and men as listed in Data Set 1 in Appendix B. Let the *response* y variable represent gender ($0 = $ female, $1 = $ male). Using the 80 gender values of y and the combined list of corresponding heights, weights, waist sizes, and pulse rates, we can use logistic regression to obtain this model:

$$\ln\left(\frac{p}{1-p}\right) = -69.3615 + 0.478932(\text{HT}) + 0.0439041(\text{WT}) - 0.0894747(\text{WAIST}) - 0.0947207(\text{PULSE})$$

In the expression above, p is the probability of a male, so $p = 1$ indicates that the child is definitely a male, and $p = 0$ indicates that the child is definitely not a male (or is a female). If we use the model above and substitute a height of 183 cm (or 72.0 in.), a weight of 90 kg (or 198 lb), a waist circumference of 90 cm (or 35.4 in.), and a pulse rate of 85 beats per minute, we can solve for p to get $p = 0.998$, indicating that such a large person is very likely to be a male. In contrast, a small person with a height of 150 cm (or 59.1 in.), a weight of 40 kg (or 90.0 lb), a waist size of 68 cm (or 26.8 in.), and a pulse rate of 85 beats per minute results in a value of $p = 0.0000501$, indicating that such a small person is very unlikely to be a male and so is very likely to be a female.

This section does not include detailed procedures for using logistic regression, but several books are devoted to this topic.