11.44 One-stop Shopping, continued Refer to Exercise 11.43. The printout that follows provides the average costs of the selected items for the $k = 4$ stores.

```
Stores
Ralphs                3.0410
Stater Brothers       2.6840
Vons                  2.9300
Wal-Mart              2.1270
```

a. What is the appropriate value of $q_{.05}(k, df)$ for testing for differences among stores?

b. What is the value of $\omega = q_{.05}(k, df)\sqrt{\frac{\text{MSE}}{b}}$?

c. Use Tukey's pairwise comparison test among stores used to determine which stores differ significantly in average prices of the selected items.

11.9 THE $a \times b$ FACTORIAL EXPERIMENT: A TWO-WAY CLASSIFICATION

Suppose the manager of a manufacturing plant suspects that the output (in number of units produced per shift) of a production line depends on two factors:

- Which of two supervisors is in charge of the line
- Which of three shifts—day, swing, or night—is being measured

That is, the manager is interested in two *factors:* "supervisor" at two levels and "shift" at three levels. Can you use a randomized block design, designating one of the two factors as a block factor? In order to do this, you would need to assume that the effect of the two supervisors is the same, regardless of which shift you are considering. This may not be the case; maybe the first supervisor is most effective in the morning, and the second is more effective at night. You cannot generalize and say that one supervisor is better than the other or that the output of one particular shift is best. You need to investigate not only the average output for the two supervisors and the average output for the three shifts, but also the **interaction** or relationship between the two factors. Consider two different examples that show the effect of *interaction* on the responses in this situation.

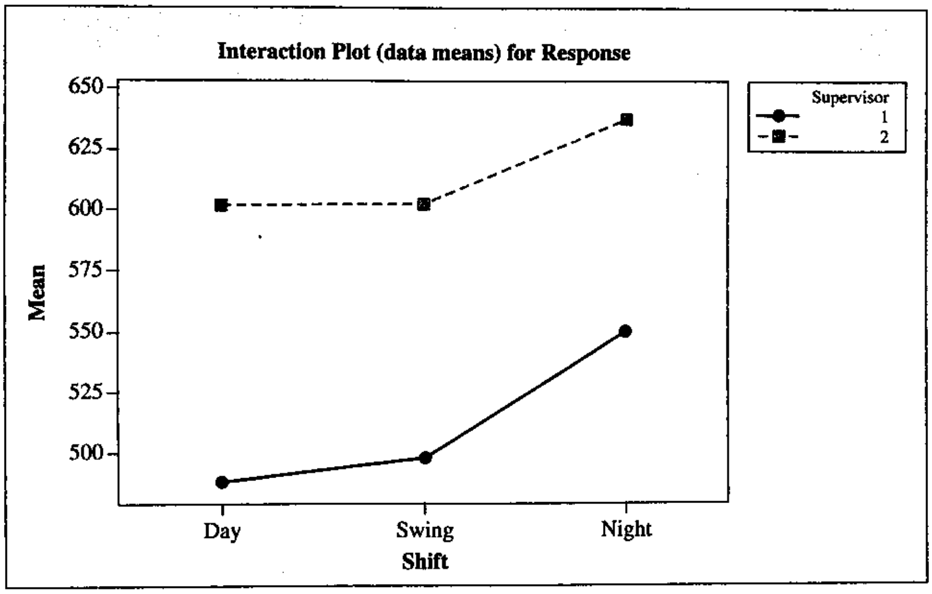
EXAMPLE 11.11

Suppose that the two supervisors are each observed on three randomly selected days for each of the three different shifts. The average outputs for the three shifts are shown in Table 11.4 for each of the supervisors. Look at the relationship between the two factors in the line chart for these means, shown in Figure 11.11. Notice that supervisor 2 always produces a higher output, regardless of the shift. The two factors behave *independently;* that is, the output is always about 100 units higher for supervisor 2, no matter which shift you look at.

TABLE 11.4 Average Outputs for Two Supervisors on Three Shifts

	Swift		
Supervisor	Day	Swing	Night
1	487	498	550
2	602	602	637

FIGURE 11.11
Interaction plot for means in Table 11.4



Now consider another set of data for the same situation, shown in Table 11.5. There is a definite difference in the results, depending on which shift you look at, and the *interaction* can be seen in the crossed lines of the chart in Figure 11.12.

TABLE 11.5 **Average Outputs for Two Supervisors on Three Shifts**

	Swift		
Supervisor	Day	Swing	Night
1	602	498	450
2	487	602	657

FIGURE 11.12
Interaction plot for means in Table 11.5