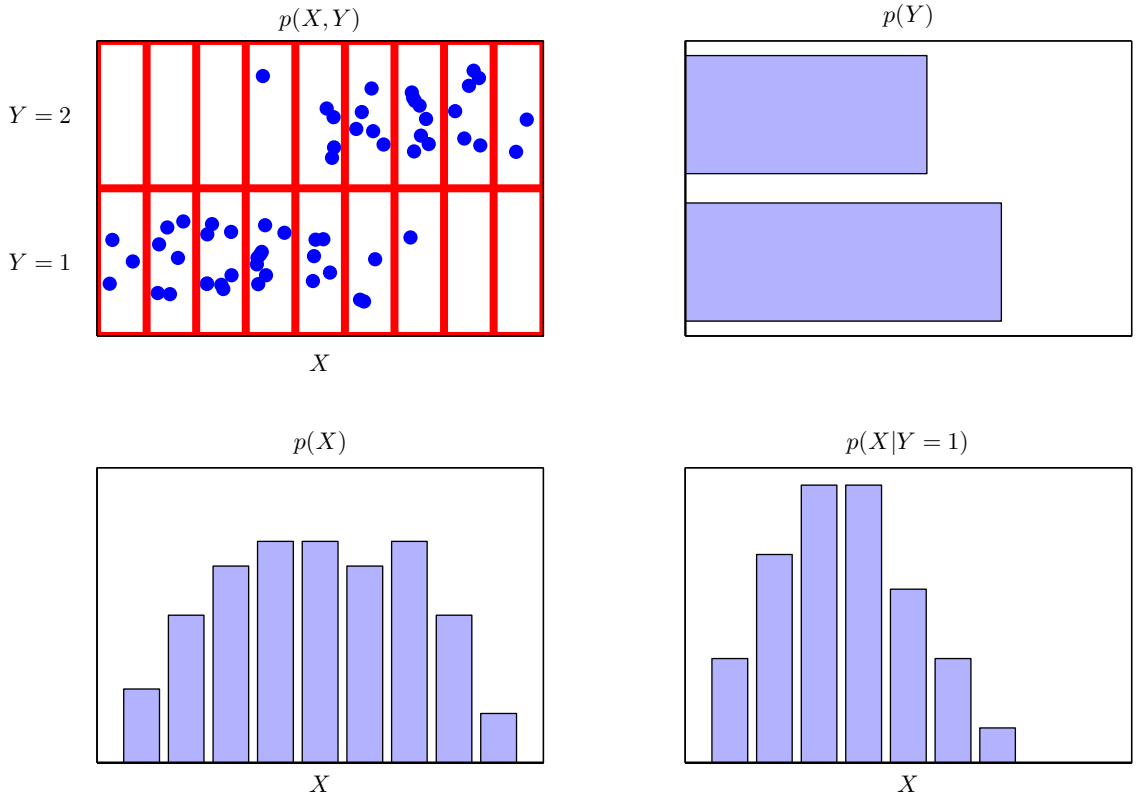


**Figure 2.5** An illustration of a distribution over two variables, $X$, which takes nine possible values, and $Y$, which takes two possible values. The top left figure shows a sample of $60$ points drawn from a joint probability distribution over these variables. The remaining figures show histogram estimates of the marginal distributions $p(X)$ and $p(Y)$, as well as the conditional distribution $p(X|Y = 1)$ corresponding to the bottom row in the top left figure.

*Section 3.5.1*

In Figure 2.5, we show a simple example involving a joint distribution over two variables to illustrate the concept of marginal and conditional distributions. Here a finite sample of $N = 60$ data points has been drawn from the joint distribution and is shown in the top left. In the top right is a histogram of the fractions of data points having each of the two values of $Y$. From the definition of probability, these fractions would equal the corresponding probabilities $p(Y)$ in the limit when the sample size $N \to \infty$. We can view the histogram as a simple way to model a probability distribution given only a finite number of points drawn from that distribution. The remaining two plots in Figure 2.5 show the corresponding histogram estimates of $p(X)$ and $p(X|Y = 1)$.