females smoke cigars, the number of cigar-smoking females is $0.017 \times 49{,}000 = 833$. The number of females who do *not* smoke cigars is $49{,}000 - 833 = 48{,}167$. See the entries of 833 and 48,167 in the table.

	C (Cigar Smoker)	$\overline{C}$ (Not a Cigar Smoker)	Total
M (Male)	4845	46,155	**51,000**
$\overline{M}$ (Female)	833	48,167	**49,000**
Total	**5678**	**94,322**	**100,000**

The table above involves relatively simple arithmetic. Simply partition the assumed population into the different cell categories by finding suitable percentages.

Now we can easily address the key question as follows: To find the probability of getting a male subject, given that the subject smokes cigars, simply use the same conditional probability described in the textbook. To find the probability of getting a male given that the subject smokes, restrict the table to the column of cigar smokers, then find the probability of getting a male in that column. Among the 5678 cigar smokers, there are 4845 males, so the probability we seek is $4845/5678 = 0.85329341$. That is, $P(M|C) = 4845/5678 = 0.85329341 = 0.853$ (rounded).

Bayes' Theorem Generalized

The preceding formula for Bayes' theorem and the preceding example use exactly two categories for event A (male and female), but the formula can be extended to include more than two categories. The following example illustrates this extension and it also illustrates a practical application of Bayes' theorem to quality control in industry. When dealing with more than the two events of A and $\overline{A}$, we must be sure that the multiple events satisfy two important conditions:

1. The events must be *disjoint* (with no overlapping).
2. The events must be *exhaustive*, which means that they combine to include all possibilities.

Example 3

An Aircraft Emergency Locator transmitter (ELT) is a device designed to transmit a signal in the case of a crash. The Altigauge Manufacturing Company makes 80% of the ELTs, the Bryant Company makes 15% of them, and the Chartair Company makes the other 5%. The ELTs made by Altigauge have a 4% rate of defects, the Bryant ELTs have a 6% rate of defects, and the Chartair ELTs have a 9% rate of defects (which helps to explain why Chartair has the lowest market share).

a. If an ELT is randomly selected from the general population of all ELTs, find the probability that it was made by the Altigauge Manufacturing Company.

b. If a randomly selected ELT is then tested and is found to be defective, find the probability that it was made by the Altigauge Manufacturing Company.