1. **Relative Frequency Approximation of Probability** Conduct (or observe) a procedure, and count the number of times that event A actually occurs. Based on these actual results, $P(A)$ is *approximated* as follows:

$$P(A) = \frac{\text{number of times } A \text{ occurred}}{\text{number of times the procedure was repeated}}$$

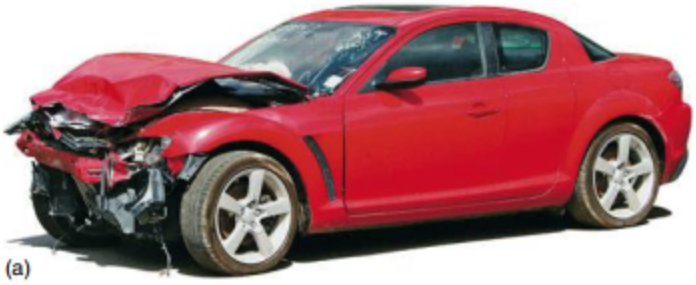
2. **Classical Approach to Probability (Requires Equally Likely Outcomes)** Assume that a given procedure has n different simple events and that *each of those simple events has an equal chance of occurring.* If event A can occur in s of these n ways, then

$$P(A) = \frac{\text{number of ways } A \text{ occur}}{\text{number of different simple events}} = \frac{s}{n}$$

CAUTION When using the classical approach, always verify that the outcomes are *equally likely*.

3. **Subjective Probabilities** $P(A)$, the probability of event A, is *estimated* by using knowledge of the relevant circumstances.

Note that the classical approach requires *equally likely outcomes.* If the outcomes are not equally likely, we must use the relative frequency approximation or we must rely on our knowledge of the circumstances to make an *educated guess*. Figure 4-1 illustrates the three approaches.



(a)

(b)

(c)

Figure 4-1 Three Approaches to Finding a Probability

(a) **Relative Frequency Approach:** When trying to determine the probability that an individual car crashes in a year, we must examine past results to determine the number of cars in use in a year and the number of them that crashed; then we find the ratio of the number of cars that crashed to the total number of cars. For a recent year, the result is a probability of 0.0480. (See Example 2.)
(b) **Classical Approach:** When trying to determine the probability of winning the grand prize in a lottery by selecting six numbers between 1 and 60, each combination has an equal chance of occurring. The probability of winning is 0.0000000200, which can be found by using methods presented in Section 4-6.
(c) **Subjective Probability:** When trying to estimate the probability of a passenger dying in a plane crash, we know that there are thousands of flights every day, but fatal plane crashes are quite rare, so the probability is very small. A good guess would be about 1 in 10 million, or 0.0000001.