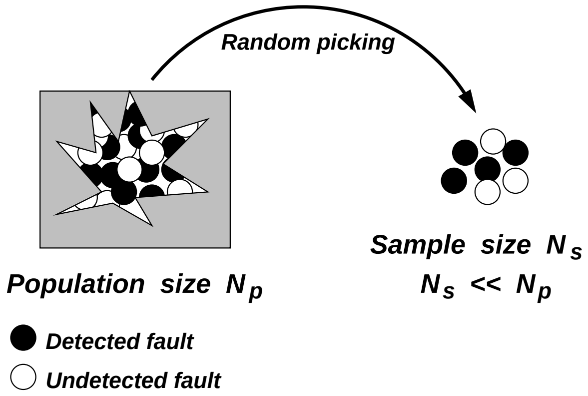

Figure 5.26: Random sampling of faults.

5.6.1 Fault Sampling

Fault sampling is a popular technique used to reduce the effort of fault simulation. In this technique, a subset of faults is randomly picked from the set of all faults. This subset, usually a small fraction of the complete fault set, is known as a *fault sample* or simply a *sample*. The faults in the sample are simulated and the *sample coverage*, i.e., the ratio of detected faults to all faults in the sample, is used as an estimate of the fault coverage in the complete fault set. The accuracy (or error bound) of the estimated coverage depends on the absolute number of faults in the sample. This number is known as the *sample size*. The error bound of the estimate can be reduced by increasing the sample size. Thus, we determine the sample size from the required accuracy with which we wish to estimate the coverage. This sample size is independent of the total number of faults in the circuit, which is assumed to be very large as compared to the sample size.

To determine the sample size that we should use, let us consider the statistician's model of Figure 5.26. A box is filled with black balls (detected faults) and white balls (undetected faults.) Given a circuit and the vector set the balls have already been colored. It is just that we do not know the fraction C of black balls in the box. This fraction is the true fault coverage. The total number, N_p, of balls (faults) is called the *population size*. We shuffle the balls in the box and randomly collect a sample of N_s balls (sample size = N_s.)

In a method, known as *sampling with replacement*, we pick one ball, note its color and then put it back in the box. So when the next ball is picked, the proportion of black and white balls remains the same as before. Although this scheme is simpler to analyze, it has the disadvantage of picking the same ball again. Therefore, fault sampling is done *without replacement*. We will develop an analysis of fault sampling using the following variables:

N_p Total number of faults in the circuit for which coverage is to be determined.

C Unknown but true fault coverage of given vectors, $0 \leq C \leq 1$. *This is the quantity being estimated.*