requirement...

14.1.5 Probability and Non-probability Sampling. Sampling methods are broadly classified as: *Probability Sampling* and *Non-probability Sampling*. When each unit in a population has a known non-zero (not necessarily equal) probability of its being included in the sample, the sampling is said to be *probability sampling*. A probability sampling is also called *random sampling*. The major types of probability sampling are Simple random sampling, Stratified random sampling, Systematic sampling, Cluster sampling, etc. The advantage of probability sampling is that it provides a valid estimate of sampling error. Probability sampling is widely used in various areas such as industry, agriculture, business, etc.

A *non-probability* sampling, also called *non-random sampling*, is a process in which the personal judgement determines which units of the population are selected for a sample. The disadvantage of non-probability sampling is that the reliability of the sample results cannot be determined in terms of probability. Non-probability sampling techniques include Purposive sampling and Quota sampling.

14.1.6 Sampling With and Without Replacement. Samples may be selected with replacement or without replacement. Sampling is said to be *with replacement* when from a finite population a sampling unit is drawn, observed and then returned to the population before another unit is drawn. The population in this case remains the same and a sampling unit might be selected more than once. If, on the other hand, a sampling unit is chosen and not returned to the population after it has been observed, the sampling is said to be *without replacement*. Here the sampling units cannot be selected again for that sample as the units drawn are not replaced. Though the successive drawings become dependent, but for all practical purposes, they are considered as independent drawings. When sampling is performed with replacement, a finite population can theoretically be considered as an infinite population and a sample of *any size* can be drawn because the population is not exhausted. But when sampling is done without replacement, the sample size cannot be greater than the population size.

14.1.7 Sampling and Non-sampling Errors. A sample being only a part of a population cannot perfectly represent the population, no matter how carefully the sample is selected. This results in a difference between the value of sample statistic and the true value of the corresponding population parameter. Such a difference is called *sampling error* for that sample. If, for example, $\bar{x}$ is the mean obtained from a sample of size n and μ is the corresponding population parameter, then the difference between $\bar{x}$ and μ is sampling error, that is

$$\text{sampling error} = \bar{x} - \mu$$

As the sample size increases, the sampling error is reduced, and in a complete enumeration (census), there is no sampling error as $\bar{x}$ becomes equal to μ. Sampling error is measured by what is known as *reliability "which is related to the variance of the sample statistic. The smaller the variance, the greater the reliability of the sample results will be"*.

Aside from sampling errors which arise because a sample comprises only a portion of the population, there are errc - which occur at the stages of gathering and processing of data, ı .dless of whether sample or a complete census is taken. These errors are called *non sampling errors*. *Non sampling errors* include all kinds of *human errors*, faulty sampling frame, biased method of selection of units, bias i response, non-response to mail questionnaires, errors of observation an measurement, processing errors such as errors in editing and coding missclassification of observations, etc. These errors can be avoide through the proper selection of questionnaires, following up the non response, proper training of the investigators, correct manipulation the collected information, etc.

14.1.8 Sampling Bias. In survey sampling, the word *bias* mean a systematic component of error which deprives a survey result of i representativeness. Bias is different from a random error in the sens that the random errors balance out in the long run while bias cumulative and does not become less as the sample size increases. Bias introduced by the following methods of selection:

14.2 PROBABILITY OR RANDOM SAMPLES

A sample is called a *random sample* if the probability of selection for each unit in the population is known prior to sample selection. The important kinds of random samples which differ in the manner in which the sampling units are selected, are discussed in the subsections that follow:

14.2.1 Simple Random Sample. A sample is defined to be a *simple random sample* (*SRS*) if it is selected in such a manner that (i) each unit in the population has an equal probability of being included in the sample and (ii) each possible sample of the same size has an equal probability of being the sample selected.

Suppose a finite population contains N units and a sample of n units is to be selected. If we sample with replacement, the number of all *possible* samples of size n that could be selected is N^n, as the first unit of the sample can be selected in N different ways, the second unit can also be selected in N ways and so on. When we sample without replacement, then the number of all possible samples when the *order* of the units is considered, is the number of *permutations* of n units from N, i.e. ${}^NP_n = N(N-1) \ldots (N-n+1)$. But in practical problems, we ignore the *order* in which the n units are drawn. Then the number of different samples of n units that can be selected when the *order* is disregarded, is the number of *combinations* of n units from a finite population of N units, i.e., $\binom{N}{n} = \dfrac{N!}{n!\,(N-n)!}$. Thus there are $\binom{N}{n}$ samples that could be selected and these samples occur with equal probabilities.

As an illustration, suppose we wish to select random samples of size 2 from a population of say, 5 students, identified as A, B, C, D and E. If we sample *with replacement*, then there are $(5)^2 = 25$ possible samples, which are listed below:

AA	*BA*	*CA*	*DA*	*EA*
AB	*BB*	*CB*	*DB*	*EB*
AC	*BC*	*CC*	*DC*	*EC*
AD	*BD*	*CD*	*DD*	*ED*
AE	*BE*	*CE*	*DE*	*EE*