Chapter 4

Sampling and Sampling Techniques

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Abstract

Sampling is required when a researcher has to do a research on a large population for the purpose of inferring about the population from the sample. However sampling might not be required in all researches especially when the population is small and can easily be handled. In order to take samples from population for a study, sampling techniques are used. The concept of sampling and the applications of the various known sampling techniques are not well understood. This chapter explains with examples the various sampling techniques, and when and how to use them in sampling.

Keywords

Samples, Sampling, Techniques, Population, Research

4.1 Introduction

There are several reasons for which sampling is done. However the paramount of them is to use it to estimate or predict the character of a population. The cost of studying every subject or object is expensive and takes time. Sampling thus reduces these by taking sizeable fraction or portion or part of the population that is most representative of it to conclude on the behaviour and character of it. It is very important to note that some experiments are destructive and if all subjects or objects of the population are to be used for the study in such cases, it would thus point to the whole population being destroyed. In order to avoid these mass destruction, sampling becomes a necessity. Also, it is good to add here and now that sampling is not required in all researches. For instance where the size of the population is too small such that it can easily be handled, there is no need for sampling. Taking for example, where a researcher has chief executive officers of ten financial institutions in a particular country as the targeted clientele for a research, the researcher can study the whole population since it is very small.

4.2 Definition of Sampling, Sampling Techniques, Samples and Population

Sampling can be defined as the act of selecting part or fraction of a population which is most representative of it in order to use it to make inferences about the population. The technique adopted in taking the sample from a population is referred as the *sampling technique.*

A sample thus is defined as the part or fraction of a population selected in order to make inferences about the population while a *population* is the entirety of all the objects or subjects being researched on.

4.3 Sampling Techniques

There are several sampling techniques known and in taking or selecting samples from a population for a study. These are broadly classified into two – probability and non probability sampling techniques. However the type to be used in the selection of a sample depends entirely on the purpose of the study. But generally the non probability types are prone to bias compared to the probability ones as they depend on the whims and caprices of the researcher.

4.4 Probability Sampling Techniques

These types of sampling are based on probability and thus it presupposes that all subjects or objects within the population under consideration are given equal chances of being selected as part of the sample. It thus avoid or reduces bias on the part of the researcher in adding subjects or objects that he or she wished or willed to be selected to constitute a sample. There are different types of the probability sampling techniques which are used in varying situations for the selection of samples from different populations. However it behoves on researcher to know the population under consideration and the appropriate sampling technique to use and how to use them in every situation encountered when conducting a research study. The probability sampling techniques are explained in detailed with applicable examples as follows:

Simple Random Sampling Techniques

This is the commonest and simplest type of probability sampling upon which other types are based. Since it is a probability sampling techniques all the subjects or objects of the population are given equal chances of being selected. In this type of sampling, once the sample sizes are determined from the

population using the appropriate formula as below, then the techniques is used in selecting this size of object from the population:

$$n = \frac{N}{1 + N(level\ of\ sgf.)^2}$$

To select the sample from the population using the simple random sampling, practically all members or objects of the population are assigned numbers on pieces of papers. This pieces of papers on which the numbers are written are shuffled and the required number is picked one after the other from all the papers until the total sample size is obtained. Objects or subjects of the population tagged with or assigned such numbers automatically become objects or subjects of the population selected to constitute the sample for a particular study.

Instead of writing numbers on pieces of papers and assigning it to the members of the population which are then shuffled and picked randomly to select the sample, alternatively a random number table can be used.

Systematic Sampling Technique

It is an example of probability sampling used for taking samples during batch production. This sampling technique requires that with a batch of items being manufactured every nth item is selected or sampled to be tested for quality assurance before the product is passed to be sold out to the ultimate users.

Assuming a car manufacturing company is doing a batch production of 1000 cars per day, and has as their corporate policy to sample 20 cars out of those produced in a batch for quality testing and check. Knowing the population size as 1000 and the sample size as 20, the researcher can use the formula below to select the 20 cars for the sample from the car population of 1000:

$$i^{th} = \frac{N}{n}$$

$$i^{th} = the\ position\ of\ item\ selected$$

$$N = Population$$

$$n = sample\ size$$

$$i^{th} = \frac{1000}{20} = 50$$

Since the i^{th} is 50, it suggest moving within the chain of production, every 50th car in the chain is to be sampled or selected as part of the sample. Thus the 50th, 100th, 150th, 200th ….etc are to be selected until all the 20 cars are selected to constitute the sample.

Taking for instance within a brewery company, 20 cartons of beer is produced and are in a production line as shown within the table with the number of each carton indicated as a right superscript of the cartons represented as letters. Assuming 10 of the cartons are to be selected for the sample, it means that by application of the formula, i.e. $i^{th} = \frac{20}{10} = 2^{nd}$.

Table 4.1 *Labeled and Numbered Cartons in the Production Line.*

^{1}[A]	^{2}[**B**]	^{3}[C]	^{4}[**D**]	^{5}[E]	^{6}[**F**]	^{7}[G]	^{8}[**H**]	^{9}[I]	^{10}[**J**]
^{11}[K]	^{12}[**L**]	^{13}[M]	^{14}[**N**]	^{15}[O]	^{16}[**P**]	^{17}[Q]	^{18}[**R**]	^{19}[S]	^{20}[**T**]

Thus every second carton in the line of production has to be sampled until the 10 cartons are obtained to constitute the sample. Thus from the above calculation, the cartons that need to be selected have been indicated in table 4.2.

Table 4.2 *Selected Cartons in the Production Line.*

^{1}[A]	^{2}[B]	^{3}[C]	^{4}[D]	^{5}[E]	^{6}[F]	^{7}[G]	^{8}[H]	^{9}[I]	^{10}[J]
^{11}[K]	^{12}[L]	^{13}[M]	^{14}[N]	^{15}[O]	^{16}[P]	^{17}[Q]	^{18}[R]	^{19}[S]	^{20}[T]

From the table, [B], [D], [F], [H], [J], [K], [K], [L], [N], [P], [R] and [T] were the cartons selected.

Stratified Sampling Technique

This technique is also a probability technique adopted when the population under consideration is made up of different groups for which if a representative sample should be obtained, all the consisting groups are to be considered for the sampling. Strata refers to groups, hence stratified sampling implies sampling based on groups.

A hypothetical case for which this kind of sampling technique can be deployed is when the behaviour of first degree mechanical degree students within a university are to be studied. If the programme duration is four years, it means the students can be put into groups such as first year, second year, third year and fourth year. Therefore the population can be grouped into four based on the levels of the students and then a number sampled from each of the groups and bulked together to form the representative sample.

Assuming the population of the mechanical students in the university is 400, comprising 100 from each level. The sample size for the population is determined by the appropriate formula and then the number divided into four. Taking for instance that a sample of 100 is to be selected. The 100 would be divided by 4 to get 25, meaning 25 students are to be selected from each of the four groups based on the levels. In order to select the 25 from the hundred students constituting each of the groups, a simple random sampling technique is used. Once the researcher succeeds in selecting the 25 students from each group, all 25 students selected from each group are put together to constitute the sample for the population understudy.

Table 4.3 *Table on how Stratified Sampling is done.*

Description of Population	**Mechanical Engineering Students**			
Size	**400**			
Stratification of Population (putting Members of Population into strata	Strata (Level 1)	Strata (Level 2)	Strata (Level 3)	Strata (Level 4)
Population size of each strata	100	100	100	100
Sample size from each strata using simple random sampling technique	25	25	25	25
Bulking of the sample from each strata to form the representative sample for the taking from the population	=25+25+25+25 100			

The table above illustrates how stratified sampling is done.

Cluster Sampling Technique

It is a probability sampling where samples are selected based on classification into various areas. It is almost handled the same way as stratified sampling but the difference here is that with the latter the population is put into different groups prior to sampling while the former the population is classified into areas prior to sampling.

Taking a hypothetical case where a researcher wants to study the garages located in Accra, because there are many garages scattered over the land of Accra, the researcher would have to demarcate Accra into zones or areas. Thus Accra could be divided into four zones – Northern, Southern, Western and Eastern. Once the population of the garages in Accra is known, the appropriate formula as known can be used to determine the sample size which must be divided into four or based on the number of areas from which samples are to be drawn.

If the number of samples to be taken from each area is established, simple random sampling techniques then is used to sample from each area sample numbers established and then bulked together to form the representative. Thus

assuming the population of garages in Accra is 200 with 50 in each zone and a sample size of 80 is to be taken. The table below shows how cluster sampling can be used to achieve that:

Table 4.4 *Table on how Cluster Sampling is done.*

Description of Population	**Garages in Accra**			
Size	**200**			
Putting Garages of Population into clusters (Areas)	Area 1 (North)	Area 2 (South)	Area 3 (East)	Area 4 (West)
Population size of each Area	50	50	50	50
Sample size from each area using simple random sampling technique	20	20	20	20
Bulking of the sample from each strata to form the representative sample for the taking from the population	=20+20+20+20 80			

Multistage sampling technique

The multistage sampling is applied when the population is large, varied and scattered such that it becomes practically impossible to get a representative sample with sampling only once. This means for a representative sample of the population to be obtained several stages of sampling would be necessary, and due to this the name multistage sampling technique was derived.

Assuming mechanical engineering students in Ghana is a target population that a researcher needs to sample from, the size of the population is first established and the sample size determined by the appropriate formula as given earlier. Since there might be so many universities and polytechnics training engineering students, the first stage of sampling probably might be to sample the identified training institutions by location or areas which results in cluster sampling; the next stage can be sampling within the samples obtained via clustered sampling to obtain samples that consist of students put into year groups or streams in the various institutions i.e. first year, second year, ……..,

final year via stratified sampling, and then the third stage sampled via the use of simple random sampling to obtain the representative sample for the targeted population.

4.5 Non Probability Sampling Techniques

Sampling techniques under this category are all deterministic and thus does not follow any probability. The choice of the samples depend mainly on the purpose for which the researcher is conducting the study; the convenience of the researcher; his judgment, the quota of the sampling of the researcher's choice; etc.

Purpose Sampling

With purposive sampling, the researcher selects the sample from the population based on the purpose for which the study is being conducted. This is non probability because members of the population are not given equal chances of being selected to constitute the sample.

Assuming the researcher's target population is the most intelligent students within Accra Polytechnic, he can choose to sample using the cumulative grade points of the students, and thus selecting those with the highest grade point. Another researcher can say some programmes are more difficult than others and so select students with the highest grade point from such programmes to constitute his or her sample instead of using the whole polytechnic. This way of sampling introduces biases into the research but nevertheless allows the researcher to sample based on the purpose of his or her study.

Convenience sampling

This is also a non probability sampling in which the researcher selects sample from a population based on his or her convenience.

Taking for instance where a researcher stays in Accra and wants to conduct a research on the programmes in the Polytechnics in Ghana. In this case the population under consideration are the Polytechnics in Ghana and since the researcher stays in Accra, the researcher can choose Accra Polytechnic to be part of the sample based on his convenience in terms of its proximity to him or her.

Judgmental Sampling

In this sampling technique the sampling is done based on the judgment of the researcher and therefore not based on probability. The sample is predetermined on the judgment of the researcher.

Assuming a lecturer has to study about the performances of students that are expected to be sent on scholarship to pursue a new programme. Based on the lecturer's knowledge and judgment about the students, he or she can sample students from the population of the students.

Quota Sampling

Quota sampling is non probability sampling. It is where the researcher takes samples from a population based on the researcher's quota. With this sampling technique, unlike stratified sampling if the researcher is to study Mechanical students within Accra Polytechnic, the researcher can choose to take whatever quota from year one, year two and year three without any formula or can decide on even the quota to be used as the sample size.

Voluntary response sampling

This is a technique that involves respondent volunteering to be considered to constitute the sample within a particular targeted population. It is non probability because the members of the sample are selected based on them volunteering.

Assuming a researcher wants to study the environmental conditions prevailing in a particular locality, because of the import of the outcome of the research, members of the locality can willingly volunteer to be part of the sample to be taken from the population to be interviewed on the situation prevailing or issues at stake.

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