**Sample Survey: Note-3**

**B.A 6TH Sem (Major)**

**Simple Random Sampling and Systematic Sampling**

Simple random sampling and systematic sampling provide the foundation for almost all of the morecomplex sampling designs based on probability sampling. They are also usually the easiest designs to implement. These two designs highlight a trade‐off inherent in selecting a sampling design: to select sample units at random to minimize the risk of introducing biases into the sample or to select samples systematically to ensure that sample units are well‐distributed throughout the population. Both designs involve selecting *n* sample units from the *N* units available in the population and can be implemented with or without replacement.

**Simple Random Sampling**

When the population of interest is relatively homogeneous then simple random sampling works well, which means it provides estimates that are unbiased and have high precision. When little is known about a population in advance, such as in a pilot study, simple random sampling is a common design choice.

**Advantages:**

* Easy to implement
* Requires little knowledge of the population in advance

**Disadvantages:**

* Imprecise relative to other designs if the population is heterogeneous
* More expensive than other designs if entities are clumped and the cost to travel among units is appreciable

**How it is implemented:**

Select *n* sample units at random from *N* available in the population. All units within the sampling universe must have the same probability of being selected, therefore each and every sample of size *n* drawn from the population has an equal chance of being selected. There are many strategies available for selecting a random sample. For large populations, this often involves generating

pseudorandom numbers with a computer and for small populations it might involve using a table of random numbers or even writing a unique identifier for every sample unit in the population on a scrap of paper, placing those numbers in

a jar, shaking it, then selecting *n* scraps of paper from the jar blindly. The approach used for selecting the sample matters little provided there are no constraints on how the sample units are selected and all units have an equal chance of being selected.

**Systematic Sampling**

Occasionally, selecting sample units at random can introduce logistical challenges that precludecollecting data efficiently. If the chance of introducing a bias is low or if ideal dispersion of sample units in the population is a higher priority that a strictly random sample, then it might be appropriate to choose samples non‐randomly. Like simple random sampling, systematic sampling is a type of probability sampling where each element in the population has a known and equal probability of being selected. The probabilistic framework is maintained through selection of one or more random starting points. Although sometimes more convenient, systematic sampling provides less protection against introducing biases in the sample compared to random sampling. Estimators for systematic sampling and simple random sampling are identical; only the method of sample selected differs. Therefore, systematic sampling is used to simplify the process of selecting a sample or to ensure ideal dispersion of sample units throughout the population.

**Advantages:**

* Easy to implement
* Maximum dispersion of sample units throughout the population
* Requires minimum knowledge of the population

**Disadvantages:**

* Less protection from possible biases
* Can be imprecise and inefficient relative to other designs if the population being sampled is heterogeneous

**How it is implemented:**

Choose a starting point at random. Select samples at uniform intervals thereafter.

**1‐in‐k systematic sample(very important)**

Most commonly, a systematic sample is obtained by randomly selecting 1 unit from the first *k* units in the population and every *kth* element thereafter. This approach is called a 1‐in‐k systematic sample with a random start. To choose *k* so than a sample of appropriate size is selected, calculate:

*k* = Number of units in population / Number of sample units required

For example, if we plan to choose 40 plots from a field of 400 plots, *k* = 400/40 = 10, so this design would be a 1‐in‐10 systematic sample.

**Stratified Random Sampling**

The way we have selected sample units thus far has required that we know little about the population of interest in advance of selecting the sample. This approach only works best when the characteristic of interest is relatively homogeneous across the population. If, however, the characteristic is heterogeneous, then estimates based on these designs will be imprecise. If we have ancillary information that is associated with the heterogeneity in the population, we can use using alternate designs to select samples which will yield increased precision for a fixed amount of effort. The first of these designs is stratified random sampling.

1. A stratified random sample is one obtained by dividing the population elements into mutually exclusive, non‐overlapping groups (strata), then selecting a simple random sample from within each stratum (stratum is singular for strata). Every potential sample unit can be assigned to only one stratum and no units can be excluded.

Stratifying involves classifying sampling units of the population into relatively homogeneous groups, usually before selecting sample units. Strata are based on information other than the characteristic being measured that is known to or thought to vary with the characteristic of interest in such a way that the characteristic is more homogeneous within strata than among strata. Therefore, any feature that explains variation in the characteristic of interest can be used as a basis for stratifying. For example, if our goal is to estimate the total number of agaves in an area and we know from previous work that agave abundance varies with soil type, we might choose to stratify the population by soil type. Because

samples within strata are likely to be more similar than those among strata, sampling error will be lower and estimates generated within strata will have higher precision than simple random samples drawn from the same population.

As most ecological systems are heterogeneous, stratifying is a common approach for increasing precision in ecological studies. Common strata in ecological studies include elevation, aspect, or other geographic features for studying plant communities and vegetation communities for studying animal communities. When choosing among potential strata, you should seek to minimize variation within strata and maximize variation among strata.

Stratified random sampling is appropriate whenever there is heterogeneity in a population that can be classified with ancillary information; the more distinct the strata, the higher the gains in precision. The same population can be stratified multiple times simultaneously.

**Advantages:**

* Higher precision of estimates
* More efficient
* Separate estimates for each stratum

**Disadvantages:**

* Requires ancillary information
* Can be more time consuming to plan and implement

**How it is implemented:**

Divide the entire population into non‐overlapping strata. Select a simple random sample from within each strata

*L* = number of strata

*Ni* = number of sample units within stratum *i*

*N* = number of sample units in the population

**Allocating Sampling Effort among Strata**

After deciding to use stratify random sampling, we need to decide how to divide sampling effort among different strata; that process is called **allocation**. When deciding where to expend effort, the question becomes how best to allocate sampling effort among strata so that the sampling process will be the most efficient balance of effort, cost, and precision. Should we allocate the same sampling effort to each stratum? If strata are of different sizes, as is usually the case, should we allocate more effort to larger stratum?

There are many strategies for allocating sampling effort, and the more information available about the population of interest, the more efficient the allocation strategy can be. Information on the variability of samples within each stratum, the relative cost of obtaining a sample from each stratum, and the number of sample units in each stratum can all help to increase sampling efficiency. Some of the most common allocations strategies are uniform, proportional to size, variation, and cost, and optimal, which simultaneously considers size, variation, and cost or whichever combination of those is available. All strategies function by creating a simple proportional multiplier by which a fixed number of samples can be allocated among strata.

**Uniform Allocation**

The simplest allocation strategy is to select the same number of samples from each stratum, which is an ideal approach if there is no information available about variability of units within strata, the cost of sampling is similar for all strata, and strata are of similar size.

**Allocation Proportional to Size or Variation**

The number of sample units to select from each stratum can be made proportional to the number of sample units (or size) within each stratum. Variation in a stratum often increases with a the size of a stratum, so in some cases this approach can be considered as a rough approach for allocating more

effort to strata that are likely to be more variable strata.

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