Abstract

When sampling from ecological, environment and geographic regions, it is observed that there is a spatial pattern among the units of population. The units that are close to each other are more similar than the units that are far apart. In this situation a simple random sample from a population where neighboring units are contiguous, is not the best representative of population; so we cannot obtain best estimates of the population parameters.

Polygonal designs are the special type of partially balanced incomplete block designs, developed under the idea that neighboring units should be avoided in the selection of samples. Polygonal designs are extensively used in the survey sampling in term of balanced sampling plans excluding contiguous units (BSEC) and balanced sampling plans to avoid the selection of adjacent units. In partially balanced incomplete block designs we do not consider the distance among the neighboring units where as in polygonal designs we consider.

Polygonal designs are usually denoted by PD (v, k, λ; α), where v denotes the number of treatments, k denotes the block size, λ is the concurrence parameter and α denotes the distance.

In this thesis there is an introduction of block designs, especially Balance Incomplete Block Designs (BIBDs), Partially Balance Incomplete Block Designs (PBIBDs), Regular Graph Designs (RGD). As polygonal designs are basically generalization of PBIBD and a special type of RGD, so it is necessary to include an introduction of these block designs in the thesis.

Polygonal designs in term of PBIBDs, Balanced Sampling plans Excluding Contiguous units (BSECs) and Balanced Sampling plans to avoid the selection of Adjacent units (BSAs) are also discussed. Also, there is a detailed discussion of the existence of polygonal designs with linear blocks (PDL). A brief review of existing work on cyclic polygonal designs is presented. Also, examples of the said designs along with their concurrence vectors are given, which show the difference between the structure of the polygonal designs and the other block designs.

The method of addition is introduced for the construction of all type of cyclic block designs and cyclic incomplete block designs and explained the construction of these designs through examples. This method is cyclic in nature. The method of addition is a more detailed and easy method of construction as compare to the other existing methods. One can directly find the properties of the designs from the set of x's.

Many authors have investigated polygonal designs with circular blocks. They attempted to establish the existence of polygonal designs as well as to find polygonal designs for different combination of parameters. But their work is limited. They provided designs for circular blocks only. Unfortunately there is no work on the construction of polygonal designs with linear blocks. In this thesis, cyclic polygonal design with linear blocks are introduced for the first time. Polygonal designs comprised of linear blocks are defined and explained. A detailed discussion of necessary conditions of the existence and construction of polygonal designs with linear blocks is presented. A large number of cyclic polygonal designs with linear blocks are constructed.

Besides considering linear blocks, efforts are made to construct circular polygonal designs for block size 4 up to 10. Algorithms are developed for the construction of designs for 4 to 10.

Although researchers has found designs for different combination of parameters, their work is limited to distance 1, and only a few designs were found for $\alpha \geq 1$ and $k \geq 4$.

There is a summary of work presented at the end of thesis. Limitation in the construction of designs are mentioned. Some suggestions for future direction in the construction of cyclic polygonal designs and polygonal designs with linear blocks are also furnished.