Populations and Samples

When making geological measurements and analysis, in what are we interested?

Are we interested in:

1.Properties of a piece of rock, core sample, … etc. **only** or

2.Properties of the rock unit (e.g. oil reservoir, aquifer, ore body, … etc.

In fact, we are interested in understanding #2 or properties of a geologic **POPULATION**.

However, #1 is important because it represents a **SAMPLE** of measurements. When making geological measurements and analysis, in what are we interested?

The Population

The total set of measurements that could, hypothetically, be taken from the entity being studied.

- Limits of geological population ➔ Spatial limits defined by a geologist
- Examples of geological populations:

1. Composition of all granites all over the world (Global population)
2. Set of permeability measurements from one carbonate member of Arab D in Ghawar Oil Field (Local population).
3. Set of Magnesite grades from Zarghat magnesite deposit near Hail (Local population).
4. Set of porosity values from Um Er-Radhuma Aquifer in the eastern province (Local population).

The statistical sample

The collection of available measurements that are a subset of the population of interest. The statistical sample is taken to **represent a population**.

Confusion!! ➔ In geology, sample = rock specimen, core, plug … etc.

Bias

It is any effect that deviates the statistical results from being a representative description of the population.

It is essential that the sample is an unbiased subset of the population.

Sources of bias

a) Samples can not be collected easily (difficult accessibility)
b) High cost of sampling (less samples = more biased results!)
c) Errors in measurements (device calibration is needed!)
d) Bad sampling design

Geological example:

Def. Of mean ➔

Population

$$X = \frac{1}{V}\int x_i$$

Hypothetical Population

$$X = \frac{1}{N}\sum x_i$$

Real-life statistical sample

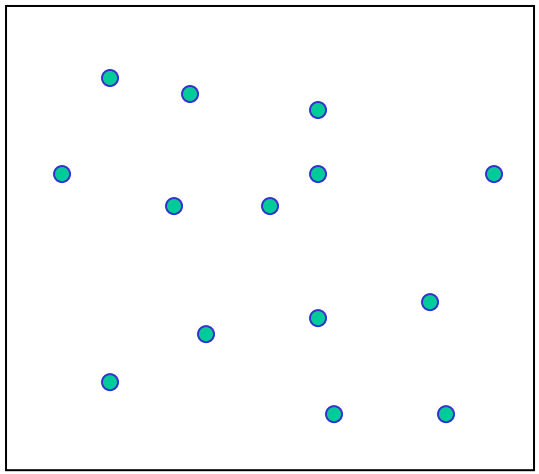
$$X = \frac{1}{n}\sum x_i$$

Sampling Strategies

Sample size: Could be decided on the basis of a pilot study.

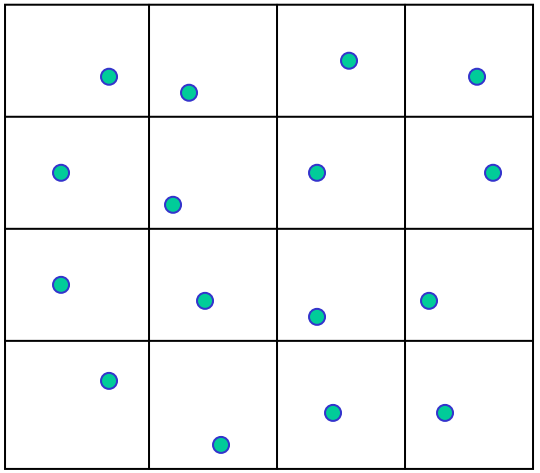
Spatial sampling schemes:

- **Random** ➔ use random number generator to decide about sampling plan

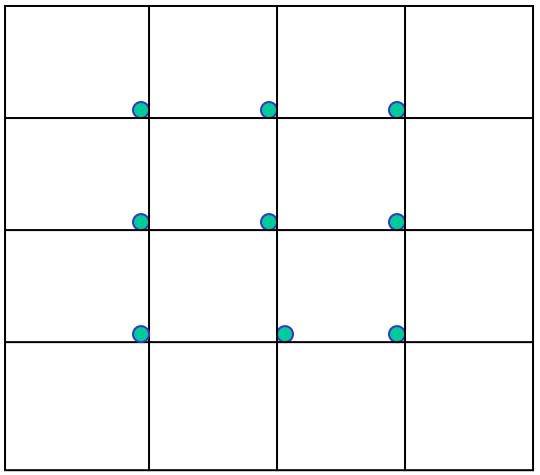


- **Uniform** ➔ use randomization sampling process within pre defined squares

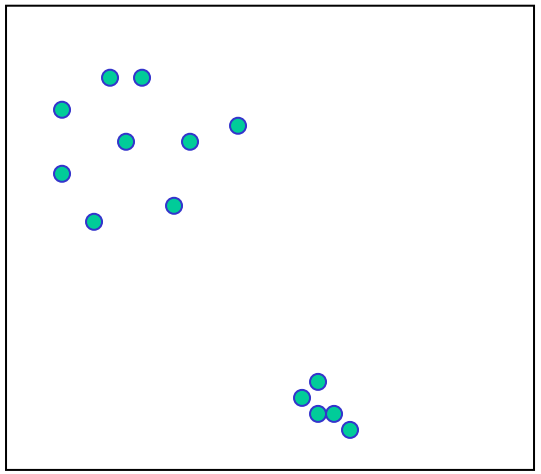
  ➔ Best to reduce bias



- **Regular** ➔ use regular squares or rectangles to sample



- **Clustered** ➔ not usually used in sampling unless forced by accessibility restrictions.



- **Traverse** ➔ sampling along a road-side, cliff, … etc.