Sampling Distributions

* Descriptive statistics]
* Inferential statistics

Dr. HARINAKSHI KARKERA

Population

set of all items / individuals

* totality of the observations with which we are concerned.

'N' — population, population mean μ, population variance σ^2 } parameters

Sample

: subset of population

'n' — sample size

Dr. HARINAKSHI KARKERA

Statistic

Why sample?

Dr. HARINAKSHI KARKERA

Sampling

Random sampling

- Simple random sampling
- Stratified random sampling
- Systematic sampling
- Cluster sampling

Non random sampling

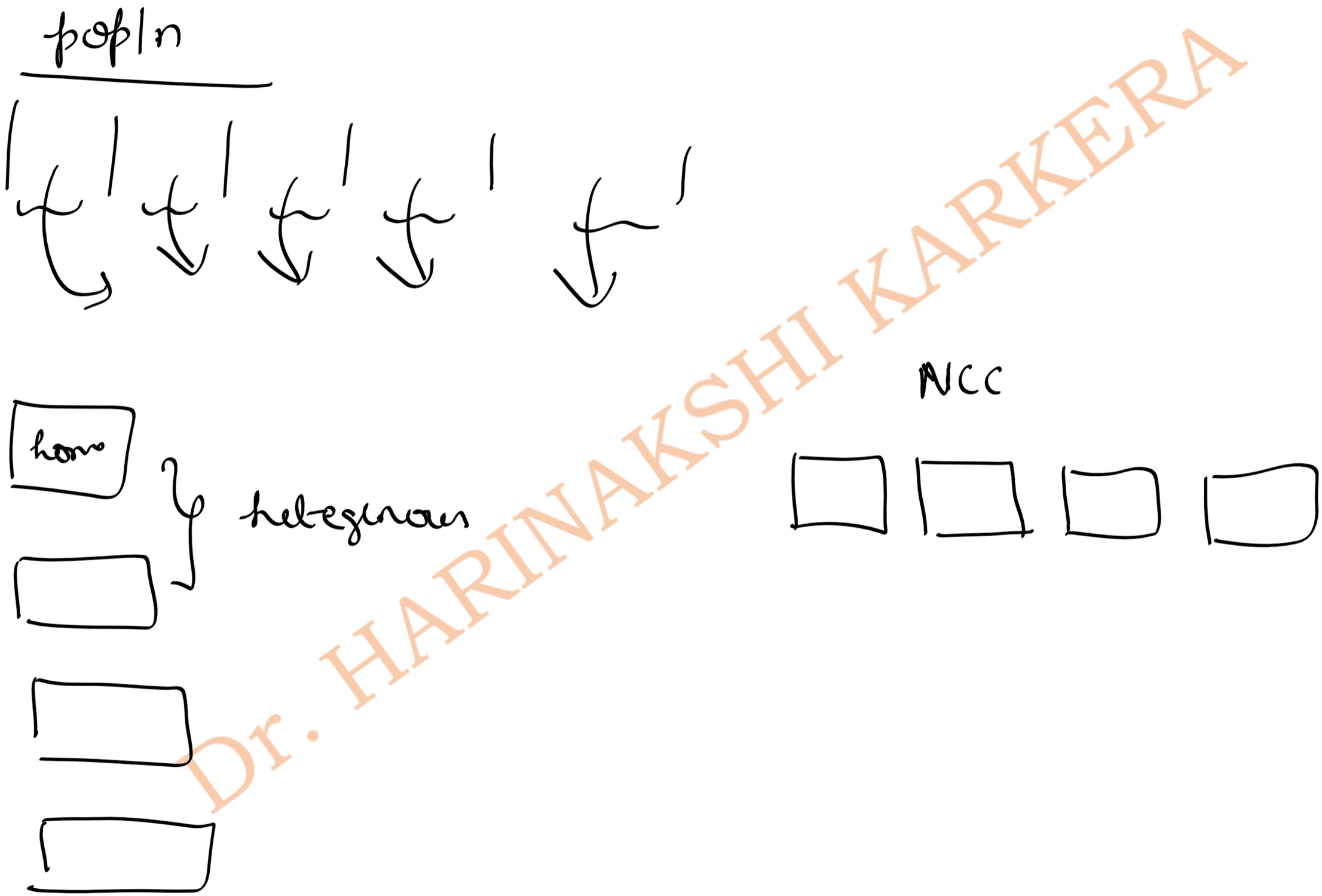
Dr. HARINAKSHI KARKERA

Simple random sampling

equal chance of being selected.

Dr. HARINAKSHI KARKERA

Stratified random sampling



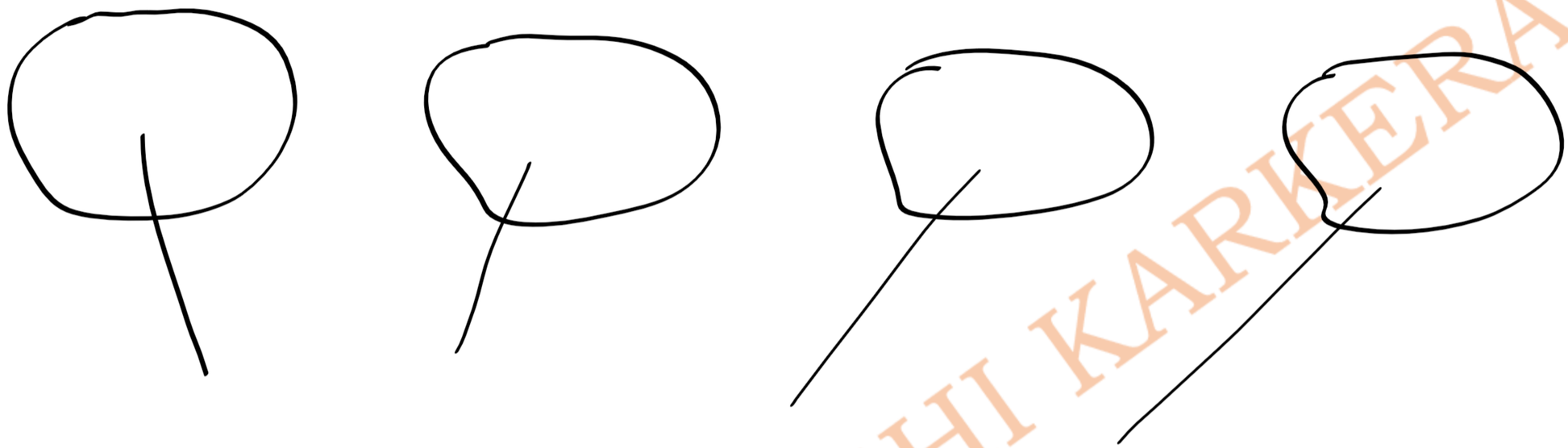
Dr. HARINAKSHI KARKERA

Systematic sampling

1 5 10

Dr. HARINAKSHI KARKERA

Cluster sampling



Dr. HARINAKSHI KARKERA

Sampling

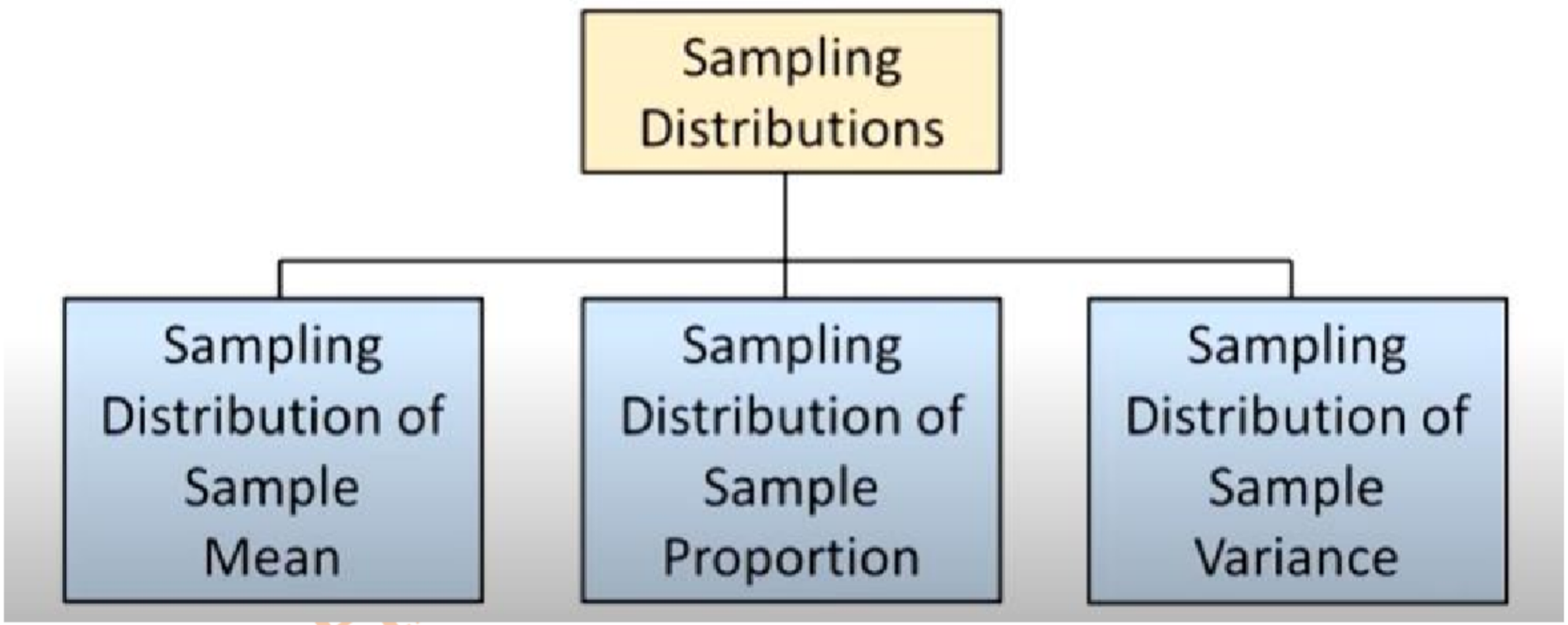
Random sampling

Non random sampling

- Convenience sampling
- Judgement sampling
- Quota sampling
- Snowball sampling

Dr. HARINAKSHI KARKERA

Types of sampling distributions



1. Sampling distribution of sample mean

Ex 1:

Population: $N = 4$

X : age of individuals

X : 18, 20, 22, 24 (years)

$P[\text{selecting an individual}] = \frac{1}{4} = 0.25$

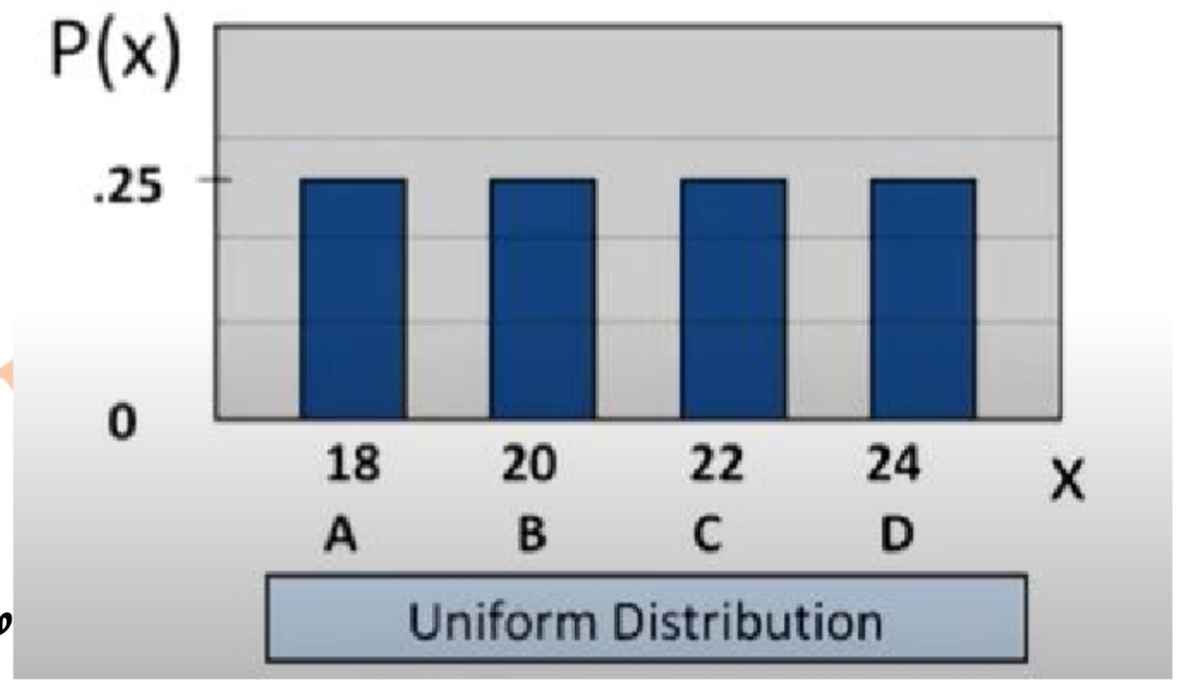
population mean

$$\mu = \frac{\sum X_i}{N} = 21$$

population variance

$$\sigma^2 = \frac{\sum (X_i - \mu)^2}{N}$$

$$\boxed{\sigma = 2.236}$$



Dr. HARINAKSHI KARKERA

Sample of size $n = 2$ (with replacement)

(18, 18), (18, 20), (18, 22), (18, 24)

(20, 18)

⋮

(24, 24)

16 possibilities

HI KARKERA

16 Sample Means

1st Obs	2nd Observation 18	20	22	24
18	18	19	20	21
20	19	20	21	22
22	20	21	22	23
24	21	22	23	24

Sample Means Distribution

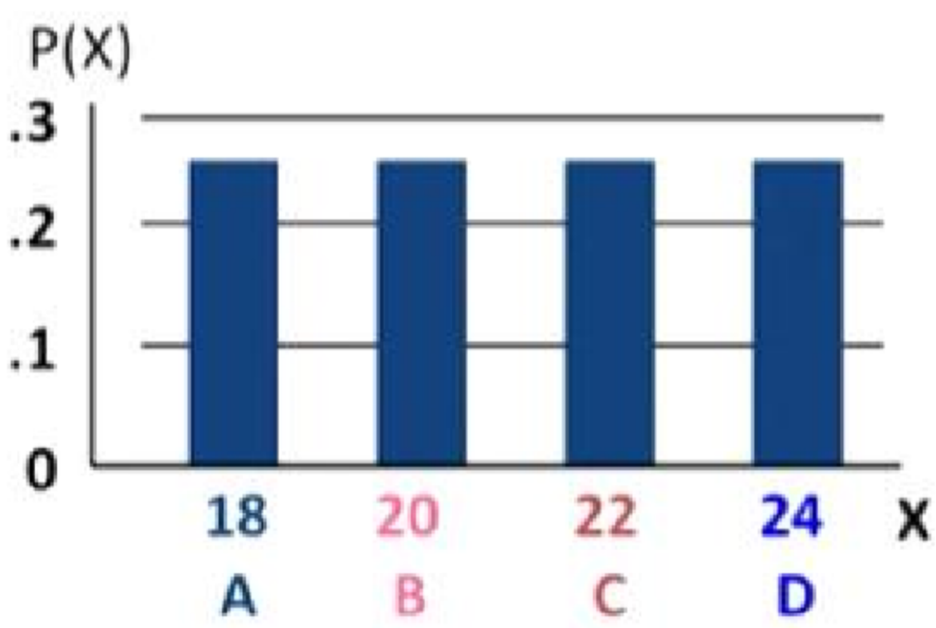
$\bar{x}_i$	f
18	1
19	2
20	3
⋮	

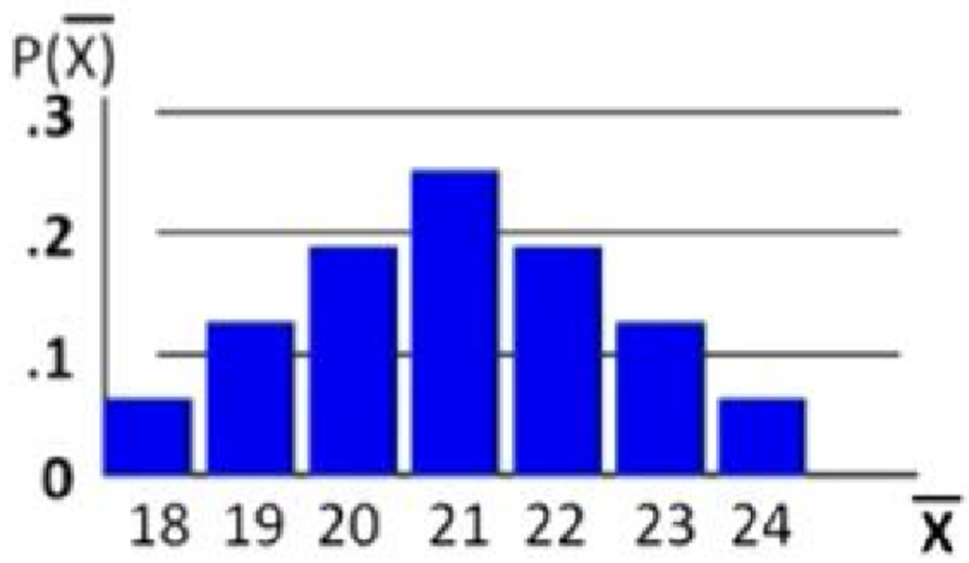
$$\mu_{\bar{x}} = \frac{18+19+\cdots+24}{16} = 21 = \mu$$

$$\sigma_{\bar{x}} = \sqrt{\frac{\sum(\bar{x}_i-\mu)^2}{16}} = \sqrt{\frac{(18-21)^2+(19-21)^2+\cdots+(24-21)^2}{16}} = 1.58$$

Population
N = 4
$\mu = 21 \quad \sigma = 2.236$

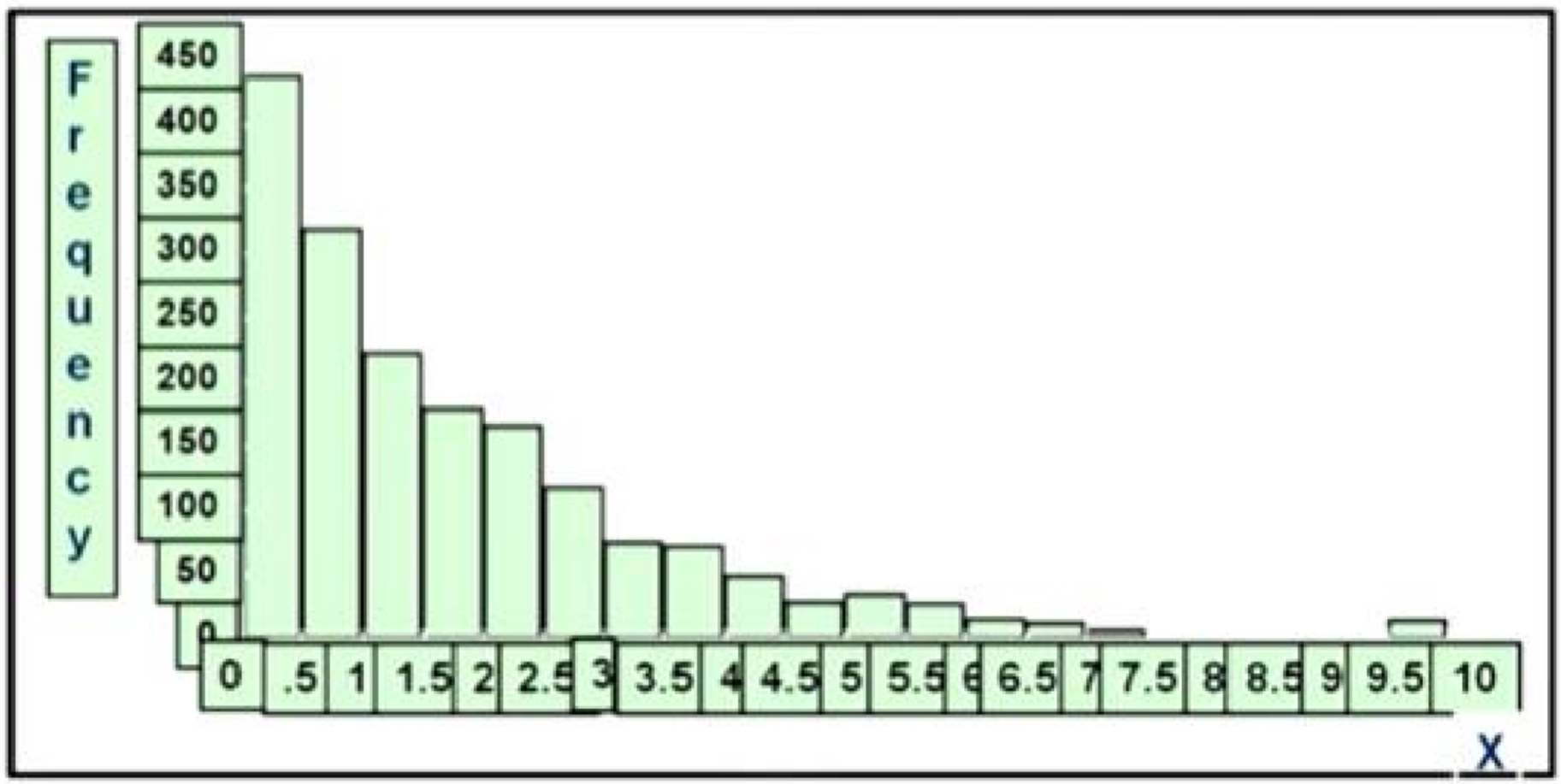
Sample Means Distribution
n = 2
$\mu_{\bar{x}} = 21 \quad \sigma_{\bar{x}} = 1.58$



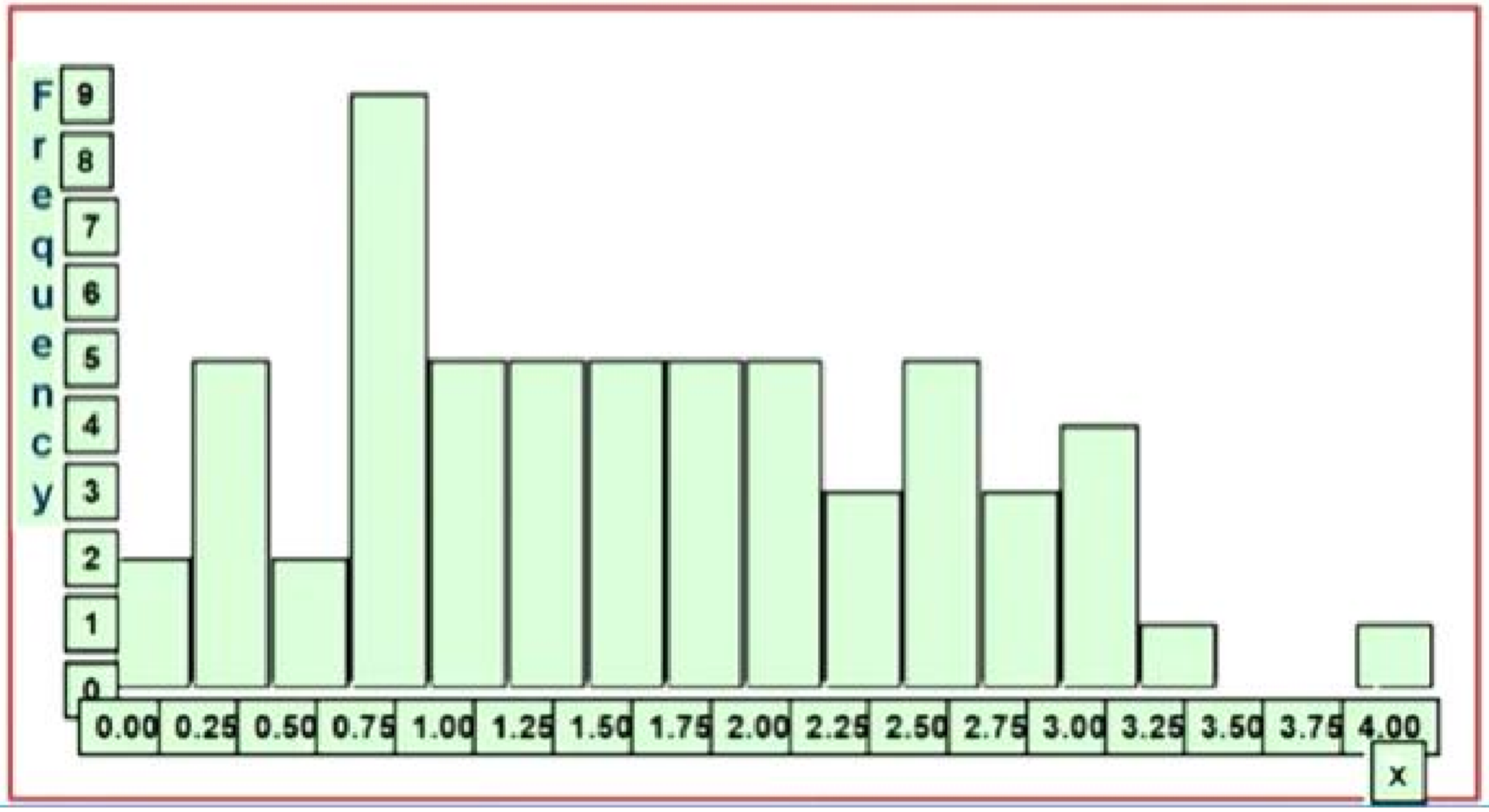


Ex 2:

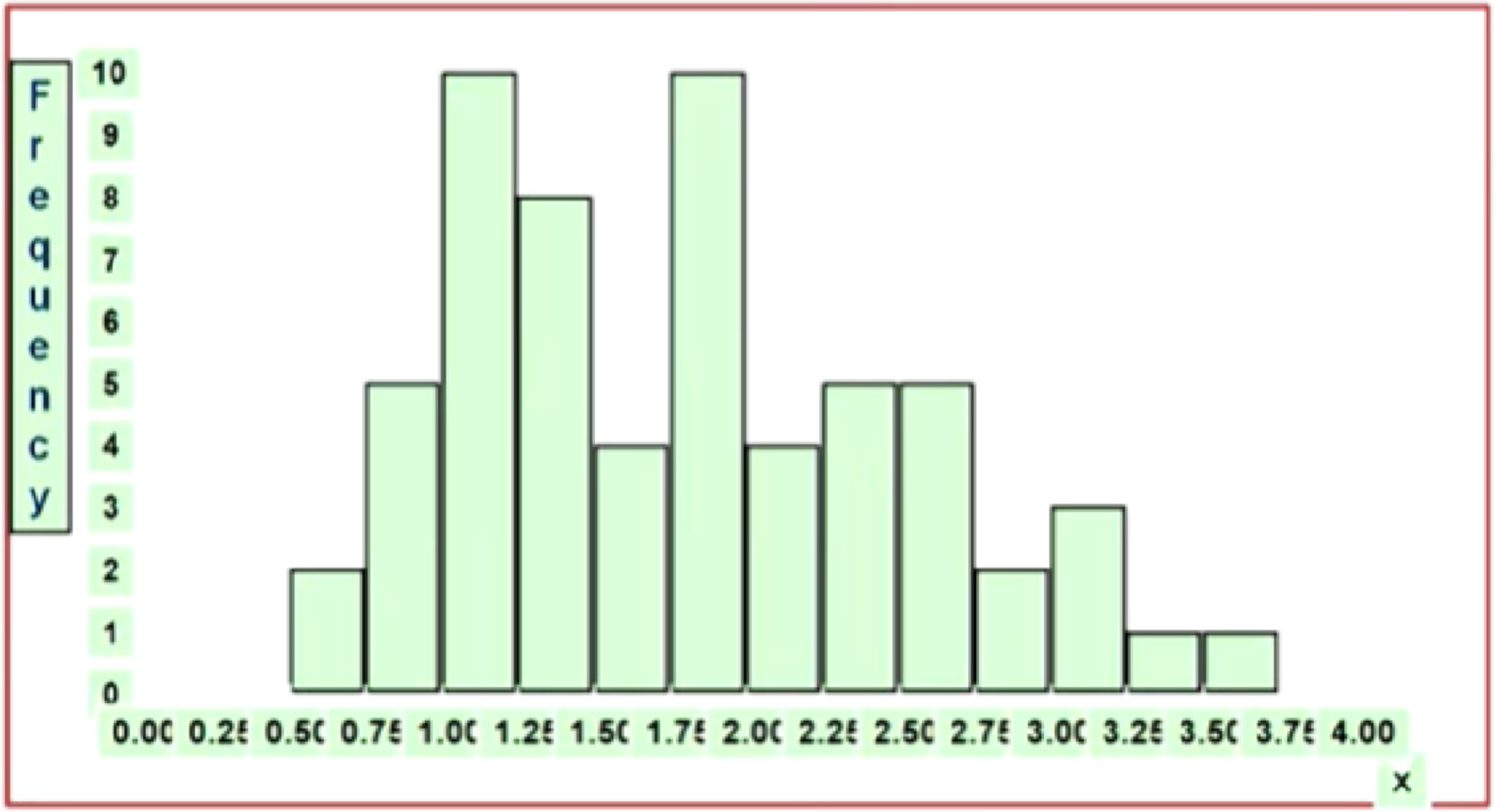
1,800 Randomly Selected Values from an Exponential Distribution



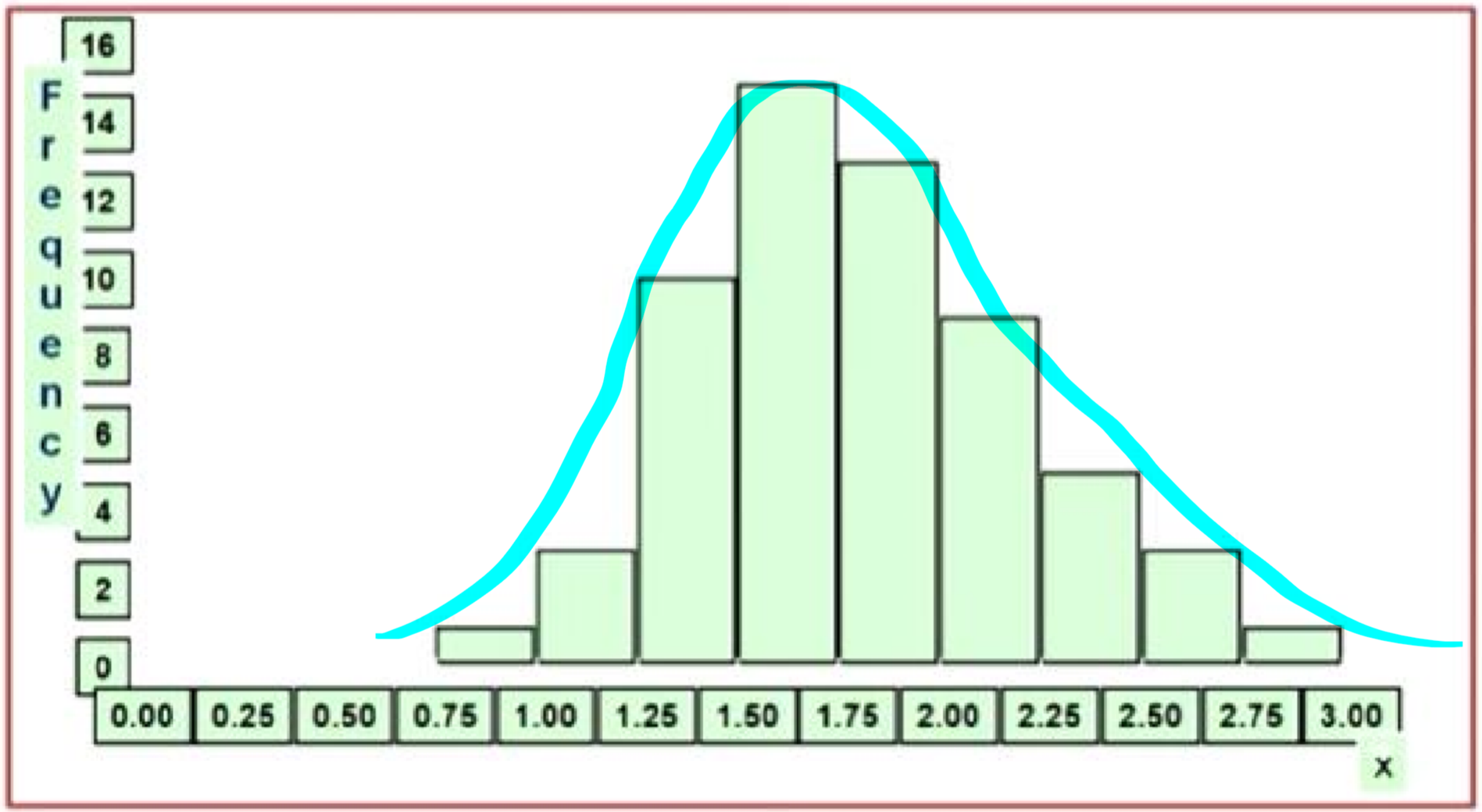
Means of 60 Samples (n = 2) from an Exponential Distribution



Means of 60 Samples (n = 5) from an Exponential Distribution



Means of 60 Samples (n = 30) from an Exponential Distribution



Sample mean

population N

$x_1, x_2, \ldots, x_n$ } sample size n

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

1,000

100 mean

Standard error of the mean

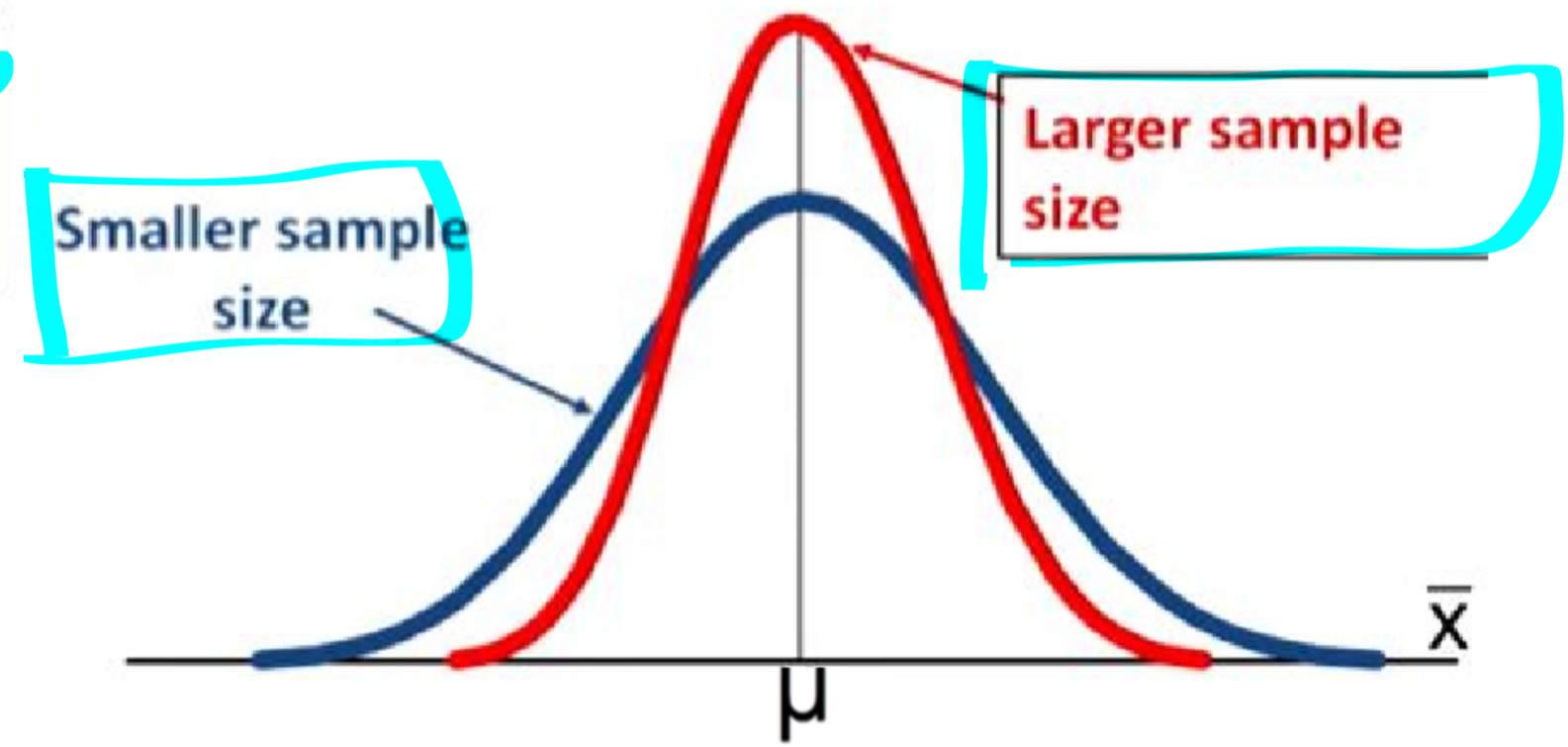
$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

σ — population s.d.

Dr. HARINAKSHI KARKERA

For sampling with replacement:

As n increases,
$\sigma_{\bar{x}}$ decreases



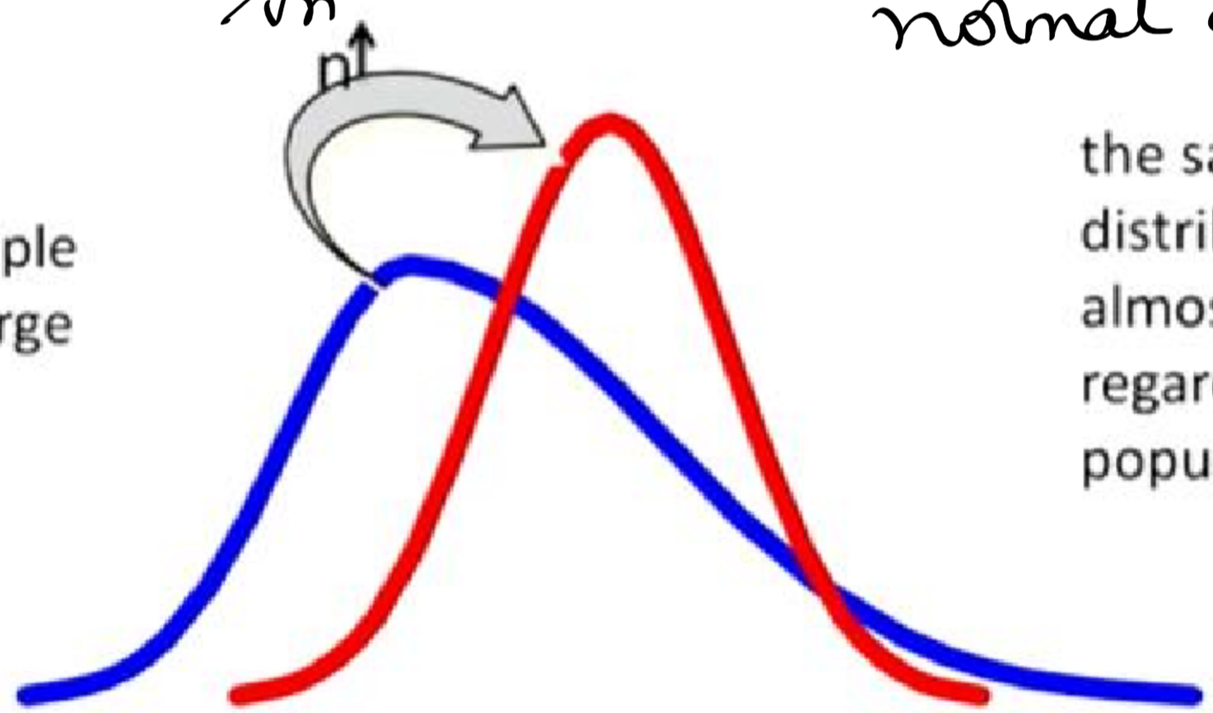
Dr. H

Central Limit Theorem

If $\bar{X}$ is the mean of a random sample of size n taken from a population with mean μ and finite variance σ^2, then the limiting form of the distribution of

$$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

as $n \to \infty$, is the standard normal distribution $N(0,1,z)$



As the sample size gets large enough…

the sampling distribution becomes almost normal regardless of shape of population

HARINAKSHI KARKERA

Problem: Suppose that a random sample of size 100 is taken from the inner diameters of certain length of pipes. If the mean & s.d of such measurements are 34.1 inches & 1.5 inches respectively. Find the probability that the sample mean will be between 34 & 34.3.

Dr. HARINAKSHI KARKERA