Some Important Notations in Sampling

Notation Name	Population	Sample
Dataset	X_i	x_i
No. of Elements	N	n
Mean	μ	$\bar{x}$
Variance	σ^2	s^2
Standard Deviation	σ	s
Proportion	π	p
Difference between Means	$\mu_1 - \mu_2$ $\mu_2 - \mu_1$	$\bar{x}_1 - \bar{x}_2$ $\bar{x}_2 - \bar{x}_1$
Difference between Proportions	$\pi_1 - \pi_2$ $\pi_2 - \pi_1$	$p_1 - p_2$ $p_2 - p_1$

Formulas for Population

$$\mu = \frac{1}{N}\sum_{i=1}^{N} X_i$$

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N} X_i^2 - \left(\frac{1}{N}\sum_{i=1}^{N} X_i\right)^2$$

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N} X_i^2 - \left(\frac{1}{N}\sum_{i=1}^{N} X_i\right)^2}$$

$$\pi = \frac{X}{N}$$

In case of two populations

$$\mu_1 = \frac{1}{N_1}\sum_{i=1}^{N_1} X_{1i}$$

$$\mu_2 = \frac{1}{N_2}\sum_{j=1}^{N_2} X_{2j}$$

$$\sigma_1^2 = \frac{1}{N_1}\sum_{i=1}^{N_1} X_{1i}^2 - \left(\frac{1}{N_1}\sum_{i=1}^{N} X_{1i}\right)^2$$

$$\sigma_2^2 = \frac{1}{N_2}\sum_{j=1}^{N_2} X_{2j}^2 - \left(\frac{1}{N_2}\sum_{j=1}^{N_2} X_{2j}\right)^2$$

$$\sigma_1 = \sqrt{\frac{1}{N_1}\sum_{i=1}^{N_1} X_{1i}^2 - \left(\frac{1}{N_1}\sum_{i=1}^{N} X_{1i}\right)^2}$$

$$\sigma_2 = \sqrt{\frac{1}{N_2}\sum_{j=1}^{N_2} X_{2j}^2 - \left(\frac{1}{N_2}\sum_{j=1}^{N_2} X_{2j}\right)^2}$$

$$\pi_1 = \frac{X_1}{N_1}$$

$$\pi_2 = \frac{X_2}{N_2}$$

Formulas for Different Sampling Distributions

1. Mean of the sampling distribution of sample mean ($\bar{x}$)

$$E(\bar{x}) \text{ or } \mu_{\bar{x}} = \sum \bar{x}P(\bar{x})$$

2. Variance of the sampling distribution of sample mean ($\bar{x}$)

$$\text{Var}(\bar{x}) \text{ or } \text{V}(\bar{x}) \text{ or } \sigma^2_{\bar{x}} = E(\bar{x}^2) - [E(\bar{x})]^2$$

$$\sigma^2_{\bar{x}} = \sum \bar{x}^2 P(\bar{x}) - \left[\sum \bar{x}P(\bar{x})\right]^2$$

3. Standard Deviation / Standard Error of the sampling distribution of sample mean ($\bar{x}$)

$$\text{S.E}\ (\bar{x}) \text{ or } \sigma_{\bar{x}} = \sqrt{E(\bar{x}^2) - [E(\bar{x})]^2}$$

$$\sigma_{\bar{x}} = \sqrt{\sum \bar{x}^2 P(\bar{x}) - \left[\sum \bar{x}P(\bar{x})\right]^2}$$

4. Mean of the sampling distribution of difference between two sample means i.e., $\bar{x}_1 - \bar{x}_2$

$$E(\bar{x}_1 - \bar{x}_2) \text{ or } \mu_{\bar{x}_1 - \bar{x}_2} = \sum (\bar{x}_1 - \bar{x}_2)P(\bar{x}_1 - \bar{x}_2)$$

5. Variance of the sampling distribution of difference between two sample means i.e., $\bar{x}_1 - \bar{x}_2$

$$\text{Var}(\bar{x}_1 - \bar{x}_2) \text{ or } \text{V}(\bar{x}_1 - \bar{x}_2) \text{ or } \sigma^2_{\bar{x}_1 - \bar{x}_2} = E[(\bar{x}_1 - \bar{x}_2)^2] - [E(\bar{x}_1 - \bar{x}_2)]^2$$

$$\sigma^2_{\bar{x}_1 - \bar{x}_2} = \sum (\bar{x}_1 - \bar{x}_2)^2 P(\bar{x}_1 - \bar{x}_2) - \left[\sum (\bar{x}_1 - \bar{x}_2)P(\bar{x}_1 - \bar{x}_2)\right]^2$$

6. **Standard Deviation / Standard Error of the sampling distribution of difference between two sample means i.e., $\bar{x}_1 - \bar{x}_2$**

$$\text{S.E}\ (\bar{x}_1 - \bar{x}_2) \text{ or } \sigma_{\bar{x}_1-\bar{x}_2} = \sqrt{E[(\bar{x}_1 - \bar{x}_2)^2] - [E(\bar{x}_1 - \bar{x}_2)]^2}$$

$$\sigma_{\bar{x}_1-\bar{x}_2} = \sqrt{\sum(\bar{x}_1 - \bar{x}_2)^2 P(\bar{x}_1 - \bar{x}_2) - \left[\sum(\bar{x}_1 - \bar{x}_2)P(\bar{x}_1 - \bar{x}_2)\right]^2}$$

7. **Mean of the sampling distribution of sample proportion p.**

$$E(p) \text{ or } \mu_p = \sum[p \times P(p)]$$

8. **Variance of the sampling distribution of sample proportion p**

$$\text{Var}(p) \text{ or V}(p) \text{ or } \sigma_p^2 = E(p^2) - [E(p)]^2$$

$$\sigma_p^2 = \sum[p^2 \times P(p)] - \left[\sum[p \times P(p)]\right]^2$$

9. **Standard Deviation / Standard Error of the sampling distribution of sample proportion p**

$$\text{S.E}\ (p) \text{ or } \sigma_p = \sqrt{E(p^2) - [E(p)]^2}$$

$$\sigma_p = \sqrt{\sum[p^2 \times P(p)] - \left[\sum[p \times P(p)]\right]^2}$$

10. **Mean of the sampling distribution of difference between proportions i.e., $p_1 - p_2$**

$$E(p_1 - p_2) \text{ or } \mu_{p_1-p_2} = \sum[(p_1 - p_2) \times P(p_1 - p_2)]$$

11. Variance of the sampling distribution of difference between two sample proportions i.e., $p_1 - p_2$

$$\mathrm{Var}(p_1 - p_2) \text{ or } \mathrm{V}(p_1 - p_2) \text{ or } \sigma^2_{p_1-p_2} = E[(p_1 - p_2)^2] - [E(p_1 - p_2)]^2$$

$$\sigma^2_{p_1-p_2} = \sum[(p_1 - p_2)^2 \times P(p_1 - p_2)] - \left[\sum\{(p_1 - p_2) \times P(p_1 - p_2)\}\right]^2$$

12. Standard Deviation / Standard Error of the sampling distribution of difference between two sample proportions i.e., $p_1 - p_2$

$$\mathrm{S.E}\ (p_1 - p_2) \text{ or } \sigma_{p_1-p_2} = \sqrt{E[(p_1 - p_2)^2] - [E(p_1 - p_2)]^2}$$

$$\sigma_{p_1-p_2} = \sqrt{\sum[(p_1 - p_2)^2 \times P(p_1 - p_2)] - \left[\sum\{(p_1 - p_2) \times P(p_1 - p_2)\}\right]^2}$$

13. Mean of the sampling distribution of variance s^2

$$E(s^2) \text{ or } \mu_{s^2} = \sum[s^2 \times P(s^2)]$$