

## 복원추출한 표본의 표본평균의 평균과 분산과 표준편차

(Mean and Variance and and Standard Deviation of Sample Mean of Samples with Replacement)

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

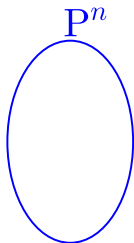
▶ End

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

$$P^n = \{(a_1, \dots, a_n) | a_i \in P\}$$

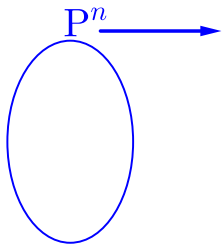


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

$$P^n = \{(a_1, \dots, a_n) | a_i \in P\}$$

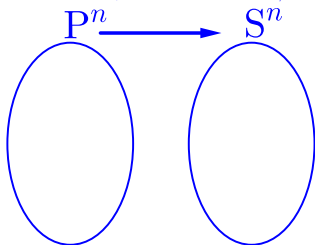


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

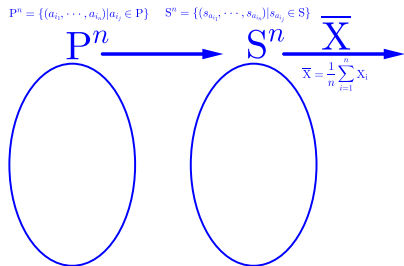
$$P^n = \{(a_{i_1}, \dots, a_{i_n}) | a_{i_j} \in P\} \quad S^n = \{(s_{a_{i_1}}, \dots, s_{a_{i_n}}) | s_{a_{i_j}} \in S\}$$



# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

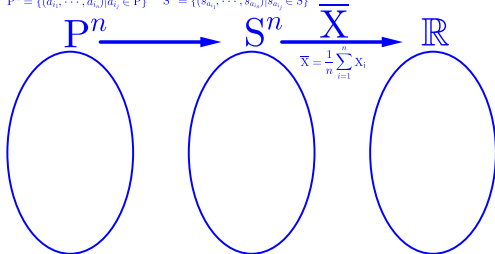


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

$$P^n = \{(a_{i_1}, \dots, a_{i_n}) | a_{i_j} \in P\} \quad S^n = \{(s_{a_{i_1}}, \dots, s_{a_{i_n}}) | s_{a_{i_j}} \in S\}$$

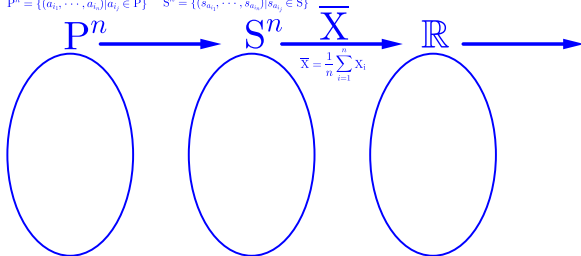


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

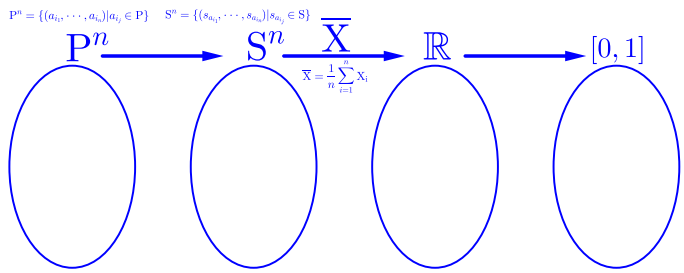
$$P^n = \{(a_{i_1}, \dots, a_{i_n}) | a_{i_j} \in P\} \quad S^n = \{(s_{a_{i_1}}, \dots, s_{a_{i_n}}) | s_{a_{i_j}} \in S\}$$





# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start   ▶ End

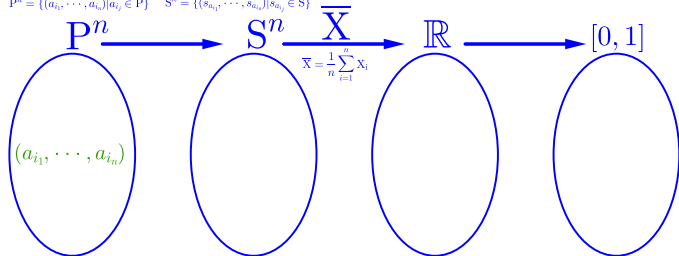


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

$$P^n = \{(a_{i_1}, \dots, a_{i_n}) | a_{i_j} \in P\} \quad S^n = \{(s_{a_{i_1}}, \dots, s_{a_{i_n}}) | s_{a_{i_j}} \in S\}$$

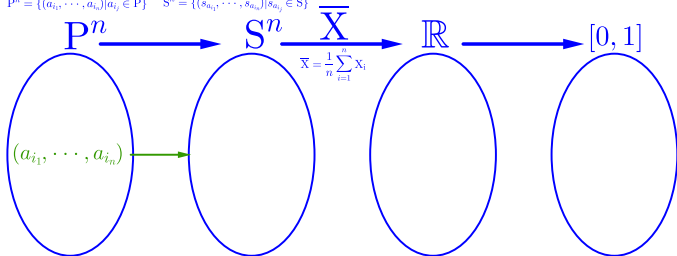


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

$$P^n = \{(a_{i_1}, \dots, a_{i_n}) | a_{i_j} \in P\} \quad S^n = \{(s_{a_{i_1}}, \dots, s_{a_{i_n}}) | s_{a_{i_j}} \in S\}$$

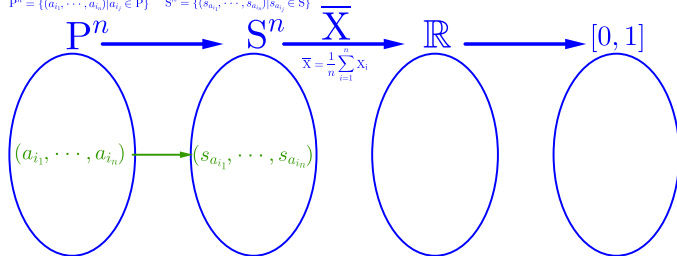


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

$$P^n = \{(a_{i_1}, \dots, a_{i_n}) | a_{i_j} \in P\} \quad S^n = \{(s_{a_{i_1}}, \dots, s_{a_{i_n}}) | s_{a_{i_j}} \in S\}$$

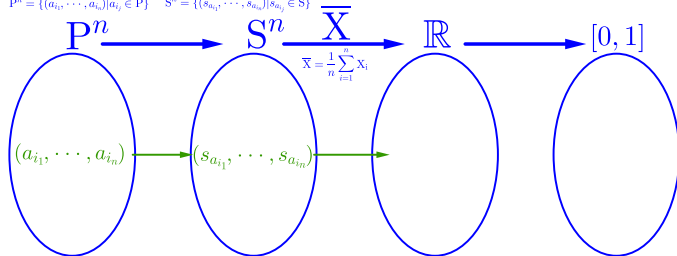


# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

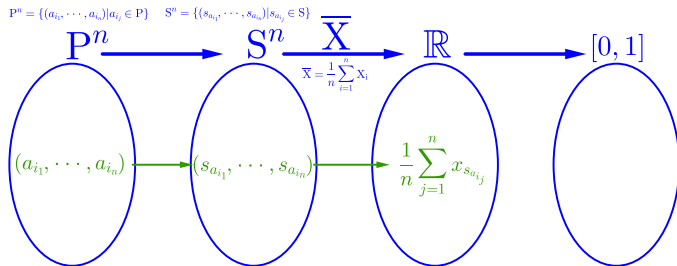
$$P^n = \{(a_{i_1}, \dots, a_{i_n}) | a_{i_j} \in P\} \quad S^n = \{(s_{a_{i_1}}, \dots, s_{a_{i_n}}) | s_{a_{i_j}} \in S\}$$



# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

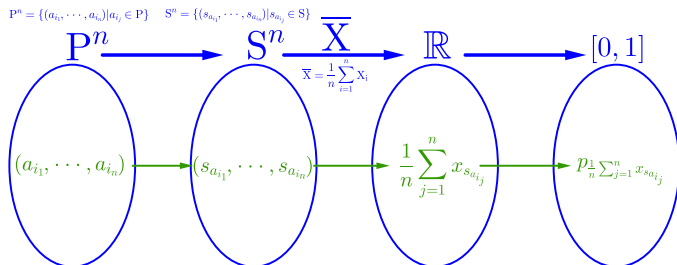




# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

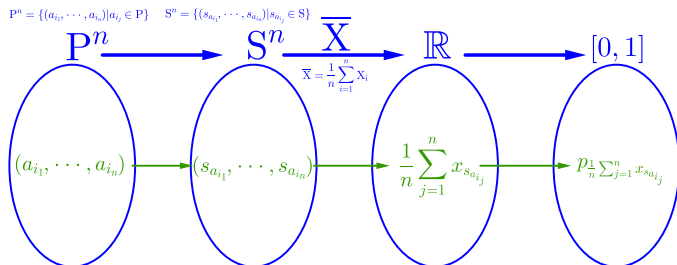




# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

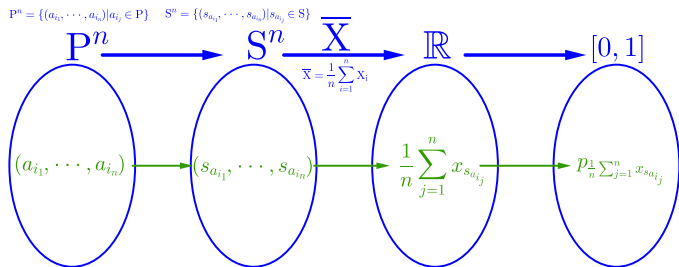


$E(\overline{X})$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

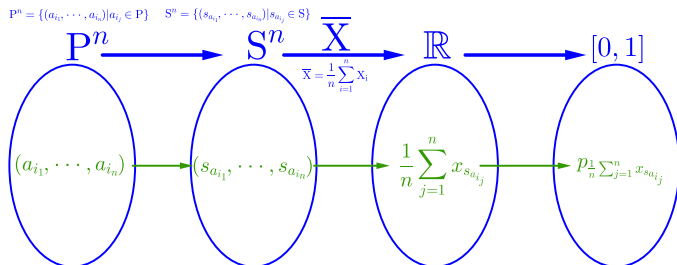


$$E(\overline{X}) = \sum_{\overline{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \overline{x} \cdot p_{\overline{x}}$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End

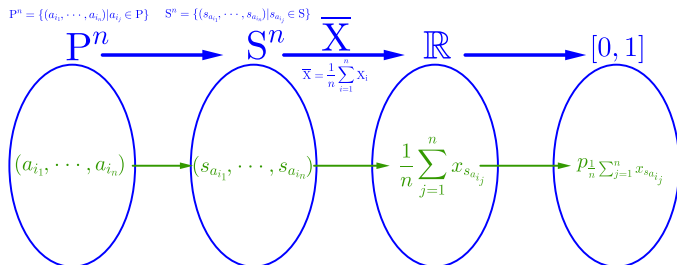


$$E(\bar{X}) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End



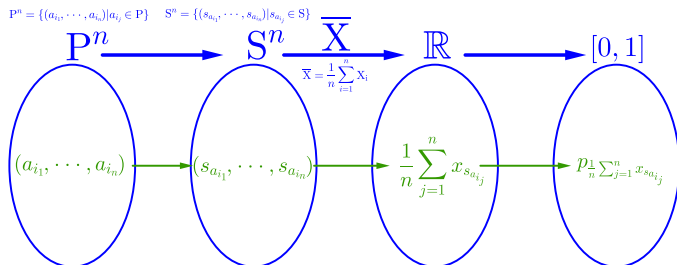
$$E(\bar{X}) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

$$E(\bar{X}^2)$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End



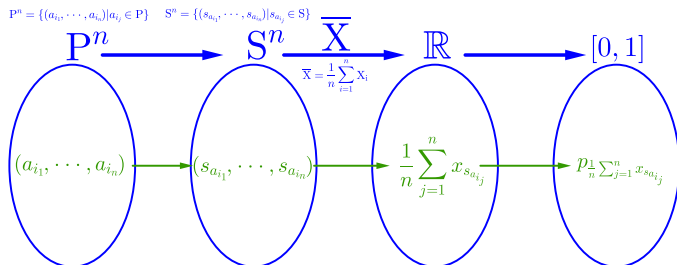
$$E(\bar{X}) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

$$E(\bar{X}^2) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x}^2 \cdot p_{\bar{x}}$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End



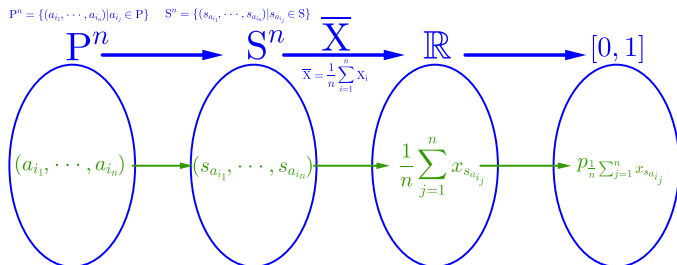
$$E(\bar{X}) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

$$E(\bar{X}^2) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x}^2 \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right)^2 \times \frac{1}{N^n} \right\}$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End



$$E(\bar{X}) = \sum_{\substack{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

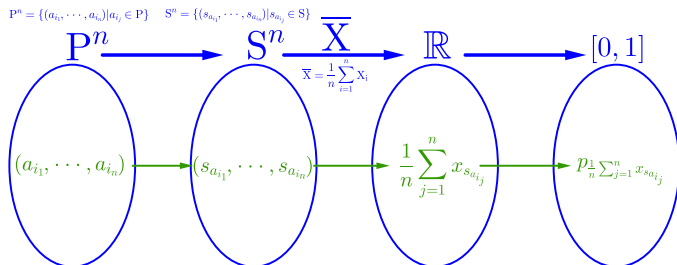
$$E(\bar{X}^2) = \sum_{\substack{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}}} \bar{x}^2 \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right)^2 \times \frac{1}{N^n} \right\}$$

$$V(\bar{X})$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End



$$E(\bar{X}) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

$$E(\bar{X}^2) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x}^2 \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right)^2 \times \frac{1}{N^n} \right\}$$

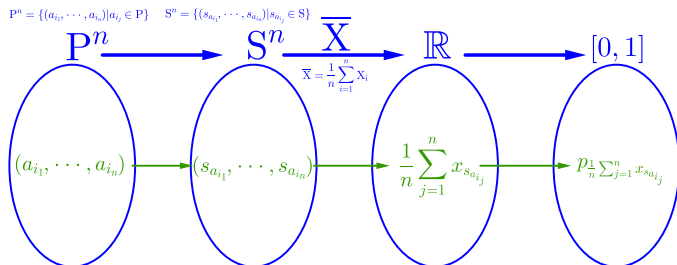
$$V(\bar{X}) = E(\bar{X}^2) - \{E(\bar{X})\}^2$$



# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End



$$E(\bar{X}) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

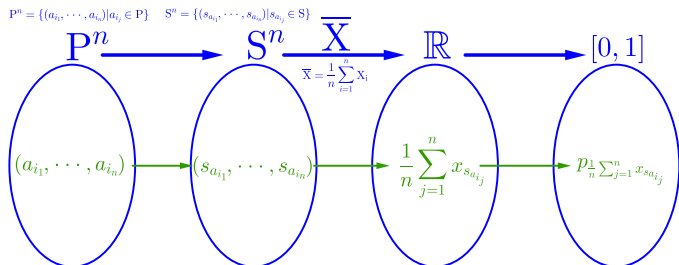
$$E(\bar{X}^2) = \sum_{\bar{x} \in \bigcup_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right\}} \bar{x}^2 \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right)^2 \times \frac{1}{N^n} \right\}$$

$$V(\bar{X}) = E(\bar{X}^2) - \{E(\bar{X})\}^2 \quad \sigma(\bar{X})$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

▶ Start

▶ End



$$E(\bar{X}) = \sum_{\bar{x} \in \bigcup_{\substack{\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}}\} \\ (a_{i_1}, \dots, a_{i_n}) \in P^n}} \bar{x} \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \times \frac{1}{N^n} \right)$$

$$E(\bar{X}^2) = \sum_{\bar{x} \in \bigcup_{\substack{\{ \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}}\} \\ (a_{i_1}, \dots, a_{i_n}) \in P^n}} \bar{x}^2 \cdot p_{\bar{x}} = \sum_{(a_{i_1}, \dots, a_{i_n}) \in P^n} \left\{ \left( \frac{1}{n} \sum_{j=1}^n x_{s_{a_{i_j}}} \right)^2 \times \frac{1}{N^n} \right\}$$

$$V(\bar{X}) = E(\bar{X}^2) - \{E(\bar{X})\}^2 \quad \sigma(\bar{X}) = \sqrt{V(\bar{X})}$$

# Mean and Variance and Standard Deviation of Sample Mean of Samples with Replacement

Github:

<https://min7014.github.io/math20230621002.html>

Click or paste URL into the URL search bar,  
and you can see a picture moving.