Experiment - 12

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* **Aim** :- To obtain the variability, combined mean and combined variance.

* **Experiment** :- An analysis of monthly wages paid to the workers of firm "A" and "B" belonging to the same industry gives the following result :-

	firm A	firm B
No. of workers =	500	600
Average monthly wage =	Rs. 186	Rs. 175
Variance of distribution of wages =	81	100

(i) Which firm, "A" or "B" has a large wage bill?

(ii) In which firm, "A" or "B" is there greater variability in individual wages?

(iii) Calculate :-

(a) the average monthly wage

(b) the variance of the distribution of wages of all the workers in the firms

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'A' and 'B' taken together.

* Theory & Formula :-

Variability :-
Variability of a data set is determined by using coeffiecient of variation. Higher coefficient of variation means High variability.

$$CV = \frac{\sigma}{\bar{x}} \times 100 \quad \text{——} \quad (i)$$

Where σ = Standard Deviation
$\bar{x}$ = Mean

Combined Mean :-
If $\bar{x}_i$ $(i = 1, 2, 3, 4, \ldots, k)$ are the means of 'k' components, series of size 'n', then the mean of composite series ($\bar{x}$) obtained by :-

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$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2 + n_3\bar{x}_3 + \cdots + n_k\bar{x}_k}{n_1 + n_2 + n_3 + \cdots + n_k}$$

$$\bar{x} = \frac{\sum n_i \bar{x}_i}{\sum n_i} \quad \text{——} \quad (2)$$

Combined Variance (σ^2) :- It is given by the formula

$$\sigma^2 = \frac{\sum n_i(\sigma_i^2 + d_i^2)}{\sum n_i} \quad \text{——} \quad (3)$$

Where $d_i = \bar{X}_i - \bar{X}$

$\bar{X}$ = combined mean

$\bar{X}_i$ = Mean of i^{th} series

* Result :-

Firm A

Total wages = 93000 Rs

C.V. of distribution of wages = 4.84

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Firm B

Total wages = 105000 Rs

C.V. of distribution of wages = 5.71

Combined mean $(\bar{x})$ = 180

Combined Variance (σ^2) = 121.36

* Interpretation :-

Total Bill of firm B > Total Bill of firm A

C.V. for firm B is greater than CV for firm A. So firm B has greater variability in individual wages.

* Calculations :-

(i) Firm-A

no. of workers (n_1) = 500

Average monthly wage ($\bar{X}_1$) = 186 Rs

So Total wages = 500 × 186

= 93000 Rs

variance of distributed wages (σ_1^2) = 81

So coefficient of variation from eq. ①

$$C.V. = \frac{\sqrt{81}}{186} \times 100 = 4.84$$

(ii) Firm-B :-

No. of workers (n_2) = 600

Average monthly wage ($\bar{X}_2$) = 175 Rs.

So Total wages = 600 × 175

= 105000 Rs

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variance of distributed wages (σ_2^2) = 100

So coefficient of variation from eq. 1

$$C.V. = \frac{\sqrt{100} \times 100}{175} = 5.71$$

→ Combined mean of both firms 'A' and 'B' from eq. 2

$$\bar{X} = \frac{500 \times 186 + 600 \times 175}{500 + 600} = 180$$

→ Combined variance from eq. 3

$d_1 = 186 - 180 = 6$, $d_2 = 175 - 180 = -5$

So

$$\sigma^2 = \frac{500(81+36) + 600(100+25)}{500 + 600}$$

$$\sigma^2 = \frac{133500}{1100} = 121.36$$