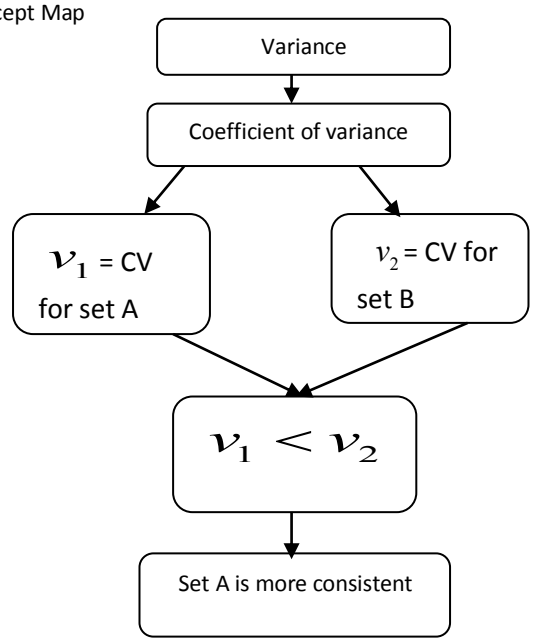
Template: Study Material

<table>
<tr><td colspan="3"><Basic Mathematics>: <22103>: <BMS>: <Statistics>: <UO _5.3>: <Study Material></td></tr>
<tr><td><Mrs.M.R.Abhang></td><td><8/7/2020></td><td><Mr.A.D.Wandhekar></td></tr>
<tr><td>Key words
Variance, coefficient of variance</td><td>Learning Objective:
Determine the variance and coefficient of variance of given grouped and ungrouped data and justifies the consistency of given simple sets of data.</td><td rowspan="2">If $\sigma = 5.4$, mean=44
find coefficient of variance.

Solution:
Coefficient of variance=
$\frac{\sigma}{\bar{x}} \times 100$
$= \frac{5.4}{44} \times 100 = 12.273$</td></tr>
<tr><td>Key Questions

Define variance.
How to check consistency of two sets?</td><td>Concept Map
 
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Explanation of Concept

Variance

The square of standard deviation is called the variance.

Raw data

$$\text{Variance} = (\text{S.D.})^2 = \sigma^2 = \sum \frac{d_i^2}{N}$$

$$\text{Coefficient of variance} = \frac{\text{S.D.}}{\text{Mean}} \times 100$$

$$= \frac{\sigma}{\bar{x}} \times 100$$

Example:

Find the variance and coefficient of variance of the following data:

49, 63, 46, 59, 65, 52, 60, 54

Solution:

$$\bar{x} = \frac{\Sigma x_i}{N}$$

$$= \frac{49 + 63 + 46 + 59 + 65 + 52 + 60 + 54}{8}$$

$$\bar{x} = \frac{448}{8}$$

$\therefore$ **$\bar{x}$ = 56**

x_i	$d_i = x_i - \bar{x}$	d_i^2
49	– 7	49
63	7	49
46	– 10	100
59	3	9
65	9	81
52	– 4	16
60	4	16
54	– 2	4
		$\Sigma d_i^2 = 324$

$$\text{S.D.} = \sigma = \sqrt{\frac{d_i^2}{N}} = \sqrt{\frac{324}{8}}$$

= 6.363

$$\text{Variance} = (\text{S.D.})^2 = (6.363)^2$$

= 40.487

$$\text{Coefficient of variance} = \frac{\sigma}{\bar{x}} \times 100$$

$$= \frac{6.363}{56} \times 100$$

=11.362

Variance for ungrouped data:

1) Calculate the mean and variance for the data:

x	10	20	30	40	50
f	12	15	17	11	9

Solution :

Key Definitions/ Formulas

Variance= σ^2

Coefficient of variance= $\frac{\sigma}{\bar{x}} \times 100$

x_i	f_i	$f_i x_i$	$d_i = (x_i - \bar{x})$	d_i^2	$f_i d_i^2$
10	12	120	– 18.437	339.92	4079.04
20	15	300	– 8.437	71.182	1067.73
30	17	510	1.563	2.442	41.541
40	11	440	11.563	133.70	1470.7
50	9	450	21.563	464.96	4184.64
	$N = \Sigma f_i = 64$	$\Sigma f_i x_i = 1820$			$\Sigma f_i d_i^2 = 10843.65$

$$\text{Mean} = \bar{x} = \frac{1820}{64}$$

$$\bar{x} = 28.437$$

$$\text{S.D.} = \sigma = \sqrt{\frac{\Sigma f_i d_i^2}{N}}$$

$$= \sqrt{\frac{10843.65}{64}}$$

$$\text{S.D.} = \sigma = 13.016$$

$$\text{Variance} = (\text{S.D.})^2$$

$$= (13.016)^2$$

$$\text{Variance} = 169.416$$

Variance for grouped data:

1) Find the variance and coefficient of variance of the following data:

C.I.	0-10	10-20	20-30	30-40	40-50
Frequency	14	23	27	21	15

Solution:

Class	f_i	x_i	$f_i x_i$	$d_i = \lvert x_i - \bar{x} \rvert$	d_i^2	$f_i d_i^2$
0-10	14	5	70	20	400	5600
10-20	23	15	345	10	100	2300
20-30	27	25	675	0	0	0
30-40	21	35	735	10	100	2100
40-50	15	45	675	20	400	6000
	$N = \Sigma f_i = 100$		$\Sigma f_i x_i = 2500$			$\Sigma f_i d_i^2 = 16000$

$$\text{Mean} = \bar{x} = \frac{\Sigma f_i x_i}{N} = \frac{2500}{100} = 25$$

$$\text{S.D.} = \sigma = \sqrt{\frac{\Sigma f_i d_i^2}{N}} = \sqrt{\frac{16000}{100}}$$

$$\text{S.D.} = 12.649$$

$$\text{Variance} = (\text{S.D.})^2 = \sigma^2 = (12.649)^2$$

$$= 159.997$$

$$\text{Variance} = 160$$

$$\text{Coefficient of variance} = \frac{\text{S.D.}}{\text{Mean}} \times 100$$

$$= \frac{12.649}{25} \times 100$$

$$= 50.596\ \%$$

Solved word Problem

An analysis of monthly wages paid to the workers in two firms A and B is as follows:

	A	B
Avg.	**186**	**175**
S.D.	**9**	**10**

Which firm is more consistent?
Solution: Let v_1 and v_2 be coefficient of variations for firms A and B

$$v_1 = \frac{\sigma}{\bar{x}} \times 100$$
$$= \frac{9}{186} \times 100$$
$$= 4.839$$
$$v_2 = \frac{\sigma}{\bar{x}} \times 100$$
$$= \frac{10}{175} \times 100$$
$$= 5.714$$
$$v_1 < v_2$$

$\therefore$ Firm A is more consistent.

Comparison of Two Sets of Observations:

Coefficient of variance is the most important relative measure of dispersion .

If two sets of observations are given, to find which set is more consistent, we have to find coefficient of variations. Less is the coefficient of variance the set is more consistent.

Example:

The data of runs scored by two batsman A and B in five one day matches is given below :

Batsman	Average runs scored	S.D.
A	44	5.1
B	54	6.31

State which batsman is more consistent?

Solution: Let v_1 and v_2 be coefficients of variance for batsman A and B.

$$v_1 = \frac{\sigma}{x} \times 100$$
$$= \frac{5.1}{44} \times 100 = 11.59$$
$$v_2 = \frac{\sigma}{x} \times 100$$
$$= \frac{6.31}{54} \times 100$$
$$= 11.68$$
$$\therefore v_1 < v_2$$

$\therefore$ Batsman A is more consistent.

	Application of Concept/ Examples in real life Coefficient of variance is used in engineering for quality control. It is also used in biochemistry , medical physics, biology, psychology, pathology ,social sciences etc. The coefficient of variation shows the extent of variability of data in a sample in relation to the mean of the data.	Link to YouTube/ OER/ video https://www.ck12.org/book/CK-12-Probability-and-Statistics-Concepts/section/5.9/
Key Take away from this UO :	Variance Coefficient of variance Consistency of sets	