



## **Standard Deviation**



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## Standard Deviation

- It is a measure of dispersion
- It measures the dispersion of the data from its mean.
- More the deviation from mean, higher the standard deviation.

Usually in GRE, you will find Standard deviation questions, in the form of Data comparison Questions.

**In almost all the cases, the question will need a good observation than calculating.**

Let's check few examples and find , how to observe the question to answer.

### Example 1 :

Col A : S.D of 0,1,2,5,7

Col B : S.D of 1,2,3,6,8

Choices:

- (i) Column A is always greater
- (ii) Column B is always greater
- (iii) Both the columns are equal.
- (iv) Relationship cannot be determined

Solution :

Observe the given information.

Col A, the deviations between numbers are (0 to 1) is 1 , ( 1 to 2 ) is 1 , (2 to 5) is 3 and (5 to 7) is 2

Like wise, check for column B , the deviation between numbers will be 1 , 1, 3, 2

By observing col A and col B, we came to know, both the data has same deviation.

Therefore, we can conclude, column A and Column B are equal.

**So, the correct option is c**

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### Example 2 :

Col A : S.D of 10,15,20,25,30

Col B : S.D of 10,20,30,40,50

Choices:

- (i) Column A is always greater

- (ii) Column B is always greater
- (iii) Both the columns are equal.
- (iv) Relationship cannot be determined

Solution :

Even here, observe the data and find the deviation for both the columns

Deviation in Column A is 5,5,5,5

Deviation in column B is 10,10,10,10

Our observation clearly shows, deviation in col B is greater, therefore, column B's S.D will be greater.

**Hence, choice (ii) is the answer.**

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**Example 3 :**

Col A : S.D of 10,11,13,14,15

Col B : S.D of 10,11,12,13,14

Choices:

- (i) Column A is always greater
- (ii) Column B is always greater
- (iii) Both the columns are equal.
- (iv) Relationship cannot be determined

Solution :

Can you now observe and tell which is greater?

Col A deviations = 1,2,1,1

Col B deviations = 1,1,1,1

In col A for one value, deviation is little high, so S.D of Col A will be greater. (Do you agree?)

**Therefore, choice (i) is correct.**

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**Example 4 :**

Col A : S.D of 12,12,12,12

Col B : 1

Choices:

- (i) Column A is always greater
- (ii) Column B is always greater

Standard Deviation

- (iii) Both the columns are equal.
- (iv) Relationship cannot be determined

Solution :

Remember one point, only if we have deviations between number, we can find the value of Standard Deviation, otherwise, the answer will be zero.

So, check col A, do you find any deviation between numbers? No , is it?  
Therefore, the value of S.D = 0 for Col A,

Now compare the values in col A and col. B ,  
Col A = 0, Col B = 1

**Therefore, Col B is greater.**

I hope, all these examples must have given you a better idea on how to proceed with standard deviation questions by observing the data.

If the deviations are not comparable between the columns or if the question requires you to find the value of standard deviation for a particular series, then you have to use the formula and find the solution.

According to the data provided, the formula has to be used.  
Let's see, the different formulas along with examples.

Case 1 :

If series of numbers are given and the question requires you to find standard deviation (S.D)

The formula used is

$$S.D = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

$x \rightarrow$  the individual value in the given series

$\bar{x} \rightarrow$  Mean or average value of the given series

$n \rightarrow$  number of items in the given series

Example :

Find the Standard Deviation of the following data :

**0, 3, 4, 8, 10**

Solution:

$x$	$x - \bar{x}$	$(x - \bar{x})^2$
0	-5	25
3	-2	4
4	-1	1
8	3	9
10	5	25
Total = $\sum x = 25$		Total = $\sum (x - \bar{x})^2 = 64$

$\bar{x} \rightarrow$  Mean or average value of the given series

$$\bar{x} = \frac{(\text{Total of } x)}{(\text{Number of items})} = \frac{\sum x}{n} = \frac{25}{5} = 5$$

$$\text{Standard Deviation (S.D)} = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} = \sqrt{\frac{64}{5}} = \sqrt{12.8}$$

$\sqrt{12.8}$  can be approximated to  $\sqrt{13}$

$\sqrt{13}$  is not a perfect square.

So, find the nearest perfect squares

$\sqrt{13}$  is between  $\sqrt{9}$  and  $\sqrt{16}$

So, the value of  $\sqrt{13}$  will lie between 3 and 4 (Do you agree?)

To find the nearest value, check whether 13 is nearer to 9 or 16.

The difference between 13 and 9 is 4

The difference between 13 and 16 is 3

If both the difference are 3, then we can conclude, the value of  $\sqrt{13} = 3.5$

But, in this case, 13 is slightly nearer to 16, since the difference is less in this case.

**Therefore, the value of  $\sqrt{13} = 3.6$  ( approximately )**

## Case 2 :

If variables and frequency of occurrence are given, the formula to be used is

$$\text{S.D} = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$$

## Standard Deviation

**Example :**

Goals scored by Manchester United in its 21 matches are as follows :

<b>Goals Scored :</b>	0	1	2	3	4
<b>Number of Matches :</b>	2	5	7	5	2

What is the Standard Deviation ?

**Solution :**

Here, Goals Scored are the variables, it is represented as “x”

Number of Matches are said to be the frequencies , it is represented as “f”

We need to find Standard Deviation (S.D)

Formula to find S.D

$$= \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$$

x we know, it is the Goals scored.

$\bar{x}$  Is the mean value, the formula to find mean is  $\sum fx / \sum f$

So, we will form the table and find the answer.

Gaol Scored(x)	No. of Matches(f)	fx	x - $\bar{x}$	(x - $\bar{x}$ ) <sup>2</sup>	f(x - $\bar{x}$ ) <sup>2</sup>
0	2	0	-2	4	8
1	5	5	-1	1	5
2	7	14	0	0	0
3	5	15	1	1	5
4	2	8	2	4	8
	$\sum f = 21$	$\sum fx = 42$		$\sum (x - \bar{x})^2 = 10$	$\sum f(x - \bar{x})^2 = 26$

$$\bar{x} = 42/21 = 2$$

**Standard Deviation**

$$\begin{aligned}\text{Standard Deviation} &= \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}} \\ &= \sqrt{\frac{26}{21}} \\ &= \sqrt{1.23} \\ &= \mathbf{1.1 \text{ (approximate)}}$$

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Case 3 :

You will be given with class intervals and frequencies.  
This will not occur in GRE as these questions will be time consuming.

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