

Master the quick ways to solve Statistics Questions

This article will give you a better idea to solve statistics questions in better and fast and the most efficient way.

However, before embarking on this article, make sure you have a basic understanding of the terms that are commonly used in statistics: Mean, Median, mode, and standard deviation.

We will limit this article to discuss only about the 2 main sub topics of statistics:

- Arithmetic Mean and
- Standard Deviation



And, at the end of the article, we will also give you some GMAT like question to apply the concepts you just learnt.

Now, let us get a sneak peak of how we will delve into the details of statistics and will make some of the concepts easy for you.

Objective of this article

In the article, we will learn:

- How to solve arithmetic mean questions if one or more things are being added to a set of numbers.
- How to easily solve standard deviation question if we are:
 - Adding/Subtracting all the elements of the set by a constant.
 - Multiplying/Dividing all the elements of the set by a constant.

So, let us begin to understand the application of arithmetic mean in 2 GMAT like question and find a better way to solve them. 😊

Arithmetic Mean

Arithmetic mean problems can be broadly put in to 2 categories:

1. When certain numbers are given, and we need to find their mean/average.
2. When mean of certain numbers are given and one number is added/removed and then we need to find their mean/average.

Let us see 1-1 example of type 1 and type 2.

❓ Ron scored 46, 55, 64, 75 in Math, English, science and history tests. What is the average marks scored by Ron?

❓ In 4 tests, the average score of Ron is 60. If he scores 84 in social science tests. What will be his new average score.

So, can you spot the difference in both the type of questions?

- Hence, we should be solving both the question in a slightly different way, right???
- However, most of the students solve both the questions in similar way.
 - By applying $\text{Mean} = \frac{\text{Sum of all the numbers}}{\text{Total Numbers}}$.

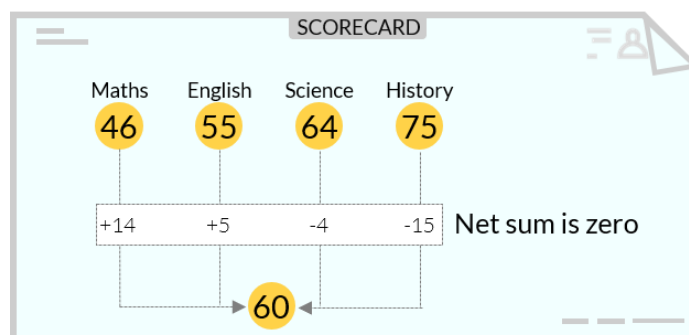
Let us solve the both the questions and see how we can find a better way to solve the type 2 question.

Type 1 Example

[e-GMAT](#) example with explanation

❓ Ron scored 46, 55, 64, 75 in Math, English, science and history tests. What is the average marks scored by Ron?

⚙️ [Solution:](#)



This is simple, Right?

- Average Marks scored by Ron = $\frac{46 + 55 + 64 + 75}{4} = \boxed{60}$.

But, let us understand what this value, 60 signifies.

- If we assume that Ron scored equal marks in every subject and total marks is 240 then in each subject he would have 60.
- So, we can assume that average is the marks that Ron has scored **equally** in each subject.

Now let us solve our second example and see how we can use the above inference in our next question.

Type 2 Example

[e-GMAT example with explanation](#)

? In 4 tests, the average score of Ron is 60. If he scores 84 in social science tests. What will be his new average score.

⚙️ Solution:

SCORECARD					
Test 1	Test 2	Test 3	Test 4	Test 5	Average
60	60	60	60	60	60
60	60	60	60	84	?
Distributed equally				(60 + 24)	
(+4.8	+4.8	+4.8	+4.8	+4.8)	64.8

You can solve this question by Mean = $\frac{\text{Sum of all the numbers}}{\text{Total Numbers}}$

But remember, we are here to learn more efficient method.

So, we can assume Ron's score in the previous 4 tests was 60, 60, 60, and 60.

- Now, Ron scored 84 in the next test. So, his average scores will be calculated by calculating the average of 60, 60, 60, 60, and 84.
 - But, here I have question.
 - What if he would have scored 60 in the social science test too. Will his average score get changed??
 - No, 60 is still the score that Ron has in all the subject.
 - So, if we are adding 84 in place of 60, then the average score of Ron will certainly be 60+ some extra average score.

- So, what will give this extra average score??
 - Extra 24 in 84, right??
 - Thus, we should also divide this extra 24 equally among all the 5 subjects.
- That is, new average score = $60 + \frac{24}{5} = 60 + 4.8 = \boxed{64.8}$.

This process may look a little complicated at first, but if you observe then this complete process involved only 2 steps.

1. Breaking 84 in to 60 (the old average) and the excess marks scored by Ron.
2. Distributing excess marks equally among all the subjects including the new subject so that new average score remains equal.

Let us now solve a difficult question.

Example 3

e-GMAT example with explanation

? Ron's Average score in the 5 tests is 70. What must be his score in the 6th test so that his new average score becomes 75?

⚙️ Solution:

SCORECARD						
Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Average
70	70	70	70	70	-	70
70	70	70	70	70	?	75
If 75 75 75 75 75 75						
(Excess marks) $(5 \times 6 = 30) + 70 =$						100

Now, this is just the opposite of previous question, right??

However, in this question, we do not have exact score in the 6th test.

So, how should we solve this one??

- Well, don't worry.
- In last question we solved from the score in the next test to the new average. And in this question, we need to solve from new average to score in the next test.
 - So, we will simply walk backwards. 😊
 - Thus, first we will find the excess average then excess number and then we will add the previous average to get Ron's score in the 6th test.

Let's do it.

- A quick observation will tell you that TILL 5 TESTS:
 - Ron's score in 5 tests can assumed to be: 70, 70, 70, 70, and 70
 - And right after the 6th tests the score in 6 tests can be assumed to be: 75, 75, 75, 75, 75, and 75.
- So, Excess average is 5. Hence excess number is $5 \times 6 = 30$
 - And by adding 30 to the previous average, i.e. 70, Ron's score in 6th test comes out to be 100.

Now, I have to emphasize over the fact that in this entire process, we only did 2 steps:

- Found the excess number
- And added it to the previous averages to get the actual score that changed the average.

But again, do not worry. It will take a little time to settle in and once you start to apply this to solve the averages question, you won't take more than 40-50 sec to solve this question.

Let us quickly brief the process that we followed to solve the above 2 questions and write our inferences so that we can use them to solve averages questions efficiently, quickly and correctly.

Key Takeaways

- As we saw in the first 2 examples that instead of using the same strategy in different type of question, we can actually use a very logical way to make our life easy. 😊
- If we are adding a number in a pre-defined set of numbers and we know their average then to find the new average by adding a new number, we only need to break the number in to two parts:
 - Average of the pre-defined set
 - Excessive number that will be distributed equally among all the numbers including the new one.
- Sometimes, we may be asked the number that changed the average of the set rather than the average.

But there is nothing to panic. We will adopt to the condition given and will follow the same strategy backwards that is:

- Find the increased average then the extra number.
- Now, adding the extra number with the previous average of the predefined set will give us the number.

Let us move on to our next sub-topic: Standard Deviation.

Standard Deviation

Before beginning our discussion on standard Deviation, we want you to understand standard deviation, what standard Deviation really is.

- It is the average deviation that a set of elements have from the mean of the set OR
- In simple words, it is the average difference between each element and mean of the set.

And I like to use the word “gap” instead of difference because this simple change of usage of the word allows us to solve the questions very easily.

But to make you realize how this will be helpful, let us solve a question by using the formula of standard deviation i.e.

$$\text{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}} \text{ where:}$$

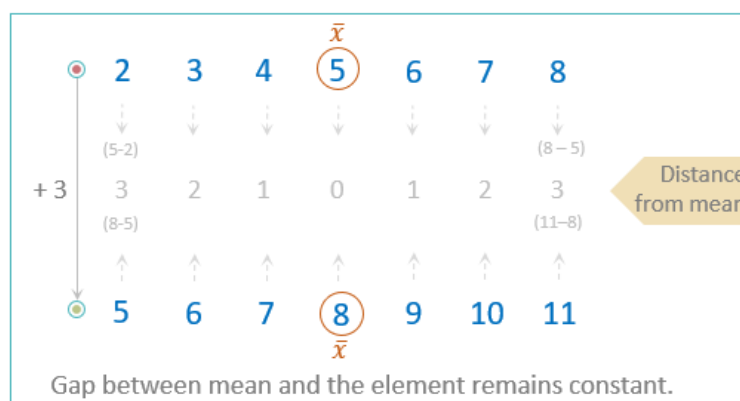
- ‘i’ is the ith element of the set.
- \bar{x} is the mean of the set.
- n is total number of element in the set.

Example 4

e-GMAT example with explanation

? The standard deviation of the of the set {2,3,4,5,6,7,8} is x. If we add 3 to every element of the given set, what will the new standards deviation be?

⚙️ Solution:



First, we will solve this question by applying the formula then we will look for an easy and a full proof way to solve this question.

By applying the formula:

- Mean = $\frac{2+3+4+5+6+7+8}{7} = 5$
- Standard Deviation = $\sqrt{\frac{(2-5)^2 + (3-5)^2 + (4-5)^2 + (5-5)^2 + (6-5)^2 + (7-5)^2 + (8-5)^2}{7}} = 2$

Now, after adding 3 in all the elements of the set, we get the set as: {5, 6, 7, 8, 9, 10, 11}

- Hence, new mean = $\frac{56}{7} = 8$
- Standard Deviation = $\sqrt{\frac{(5-8)^2 + (6-8)^2 + (7-8)^2 + (8-8)^2 + (9-8)^2 + (10-8)^2 + (11-8)^2}{7}} = 2$

So, the standard deviation is same in both the cases.

Now, let us solve the questions by a logical way and yes, in this way we will make use of the change of the word “difference” to “gap”.

Logical way:

Here “gap” signifies the “distance between two elements” that we call as difference.

So, if you think carefully then will the gap between two elements change if we add the same number to both the elements??

- Gap or difference between 2 and 5 is 3 and even after adding 3 to both the elements, the gap between 2+3 and 5+3 will be same as 3 and 3 gets cancelled.
- So, we figured out that in our question the gap between mean and all the elements will remain the same.
 - Thus, their standard deviation will remain the same.
 - And, hence the new standard deviation will also be x.
 - See it saved your 40 seconds to calculate the same value again. 😊

So, can you see how easy it becomes to think for standard deviation in terms of gap between two number.

So, instead of adding the same number in all the elements, had we subtracted the same number from all the elements, will the standard deviation change?

- The gap will still remain the same so standard deviation won't change.

This is a very useful inference!!!

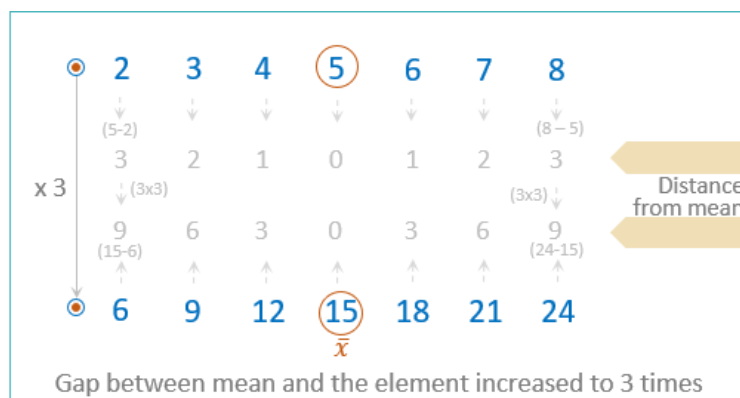
This is a very useful inference!!! Let us rephrase it again so that it gets immersed into our brains completely.

- *If we add/subtract the same number from the set of elements, then its standards deviation will remain the same.*

With this learning, let us discuss what will happen if we multiply all the numbers of the set by the same number.

But, before taking one question and discussing it further, I would like to ask this one question to you:

- What do you think will happen if we multiply the gap/difference/distance between two elements??
 - Will the gap change or remain the same??
 - If your answer is : Yes, the gap will change then congratulations!!! You are on the right way.
 - However, if your answer is not correct then remember how we checked when happens in the case addition.
 - We took two number 2 and 5 and then added 5.
 - Do the process again but this time multiply by 3.



So, I am sure you must have understood that multiplying all the numbers by the same number will change the gap between two number and hence the standard deviation.

But let us take one example and understand how this change will be reflected in the new standard deviation.

Example 5

e-GMAT example with explanation

The standard deviation of the of the set {2, 3, 4, 5, 6, 7, 8} is x. If we multiply every element of the given set by 3, what will the new standards deviation be?

Solution:

Now, we can skip the standard deviation part of {2, 3, 4, 5, 6, 7, 8} as it is 2.

Let us calculate the standard deviation of {2×3, 3×3, 4×3, 5×6, 6×3, 7×3, 8×3}

- New mean = $\frac{2 \times 3 + 3 \times 3 + 4 \times 3 + 5 \times 6 + 6 \times 3 + 7 \times 3 + 8 \times 3}{7} = \frac{3 \times (2 + 3 + 4 + 5 + 6 + 7 + 8)}{7} = 3 \times 5$
- Standard Deviation = $\sqrt{\frac{(2 \times 3 - 3 \times 5)^2 + (3 \times 3 - 3 \times 5)^2 + (3 \times 4 - 3 \times 5)^2 + (3 \times 5 - 3 \times 5)^2 + (3 \times 6 - 3 \times 5)^2 + (3 \times 7 - 3 \times 5)^2 + (3 \times 8 - 3 \times 5)^2}{7}}$
- $\sqrt{\frac{9(2 - 5)^2 + 9(3 - 5)^2 + 9(4 - 5)^2 + 9(5 - 5)^2 + 9(6 - 5)^2 + 9(7 - 5)^2 + 9(8 - 5)^2}{7}} = \sqrt{(9 \times 4)} = 3 \times 2$
- Now, if you observe than 3×2 is nothing but **Number being multiplied × Previous Standard deviation.**

So, we can figure out that if we multiply all the elements of a set by the same number then new standard deviation will also get multiplied by the same number.

That was a very important learning. So, let's just write all what we learnt about the standard deviation.

Key Takeaways

- On adding/subtracting the same number to all the numbers of the set will not change the standard deviation of the set.
- On multiplying/Dividing all the numbers of a set by the same number, the standard deviation will also get multiplied and divided by the same number.

With these two learning, let us solve one GMAT-like question.

Example 6**e-GMAT** example with explanation

In an MBA entrance exam, GMAT, scores are calculated by adjusting the students score by using the formula $y = x \times \frac{3}{2} + 55$ where x is the original score of the student and y the adjusted score of the student. If the standard deviation of the original score of all the students that took the test is 450 then what will be the standard deviation of the adjusted score.

Solution:

- Original standard deviation of all the participants is 450.
- To get the adjusted score, we first multiplied the original score by $\frac{3}{2}$
 - So, the original standard deviation will also get multiplied by $\frac{3}{2}$
- Then we added 55 in the original score of all students. But will this change the standard deviation of the students??
 - No. Adding same number to all number does not changes the standard deviation.
- Thus, the new standard deviation will be $450 \times \frac{3}{2} = 675$.

Hence, 675 is the standard deviation of all the test takers.

Key Takeaways from the article

- In this article, we learnt how to apply a logical method to solve averages and standard deviation questions.
- On adding a new number to the set number then changed averages is Previous average + Excess number/ total number in the set including the added one
- We can also get the number if we know the new average and the previous average of the set some numbers.
 - The number added/removed= Previous average + Changed average \times number of elements in the set.
- On adding/subtracting the same element from all the elements of a set, its standard deviation will not change. The standard deviation will remain the constant.
- On multiplying/dividing every element of a set from the same number, the standard deviation of the set also gets changed and it get multiplied or divided by the same number.

Upcoming e-GMAT article on Statistics

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Read More such articles: <https://gmatclub.com/forum/e-gmat-quant-consolidated-list-of-useful-articles-and-question-series-198030.html>

Next week, we will post one more article in the series of statistics: - "**Master quick way to solve Statistics Question- II**" where you will learn the concepts of **Mean, Median and Mode**.

So, we have now come at the end of this article.

See you in a healthy discussion in the practice questions.



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