

The student is working on the following problem:

Table 1. shows the number of goals that each football player striker scored between 2007 and 2011. Who is the most consistent player? Immagine a measure of "consistency" and justify why you think your method is correct.

Year	Mike Arwen	Dave Backhand	Ivan Right
2007	13	12	14
2008	12	14	10
2009	15	16	18
2010	17	15	18
2011	13	13	15

The solution of this problem is:

The concept of standard deviation is the usual way to measure consistency but it is not expected that the student knows it. Any measure proposed by the student to measure consistency is acceptable as long as it can be justified.

Example of canonical solution: computing the variance (or standard deviation) for each player: First, compute the mean:

Mean number of goals for Mike: 14

Mean number of goals for Dave: 14

Mean number of goals for Ivan: 15

Then, compute the sum of square deviations from the mean for each player.

Then devide by the number of data points to get the variance:

Variance for Mike:  $12/5 = 3.2$

Variance for Dave:  $10/5 = 2$

Variance for Ivan:  $44/5 = 8.8$

So according to the variance, Dave is the most consistent player.



Hello! I am your tutor. Can you walk me through your solution?

Hey! So honestly, I don't really know where to start. They want measures of consistency, but I haven't learned about anything specifically called "consistency" in math class. Is there like, a formula or something that I'm supposed to use?



That's a good starting point--recognizing that you need to determine what "consistency" means in this context. Can you think of any way to describe what it means for these scores to be consistent? What would you expect to see in the data if a player was scoring very consistently over these years?

If a player is consistent, I think their number of goals wouldn't change a lot from year to year. Like, their scores should be pretty close to each other, without big jumps or drops. So maybe we could look at how much the scores go up or down each year? If the changes are small, that could mean they're consistent.



That's a very insightful observation. You're thinking about the changes between the scores year to year. How might you capture that idea using the numbers in the table? What could you do with those changes to create a numerical measure of consistency?

Maybe I could take each player's scores and find the differences between the numbers for each year. Like, how you might do with a sequence of numbers to find the difference from one to the next. Then add up those differences for each player, and the player with the smallest total change could be the most consistent. Does that sound okay?



That's a solid approach—you've described a way to quantify the year-to-year change for each player. Once you have those differences, what are you thinking of doing next with those numbers?

I'd probably just add up all the differences for each player, but wait, I think I need to take the absolute value of the differences first, 'cause it doesn't matter if they scored more or less than the previous year, just how much it changed. So I'd add up the absolute values of the differences for each player, and the one with the smallest total would be the most consistent, right?





That's an interesting way to handle the data. Can you now apply your method to the table and see what results you come up with?

Sure, let me do that.



For Mike Arwen:

Differences between years are:

$$2008 - 2007: |12 - 13| = 1$$

$$2009 - 2008: |15 - 12| = 3$$

$$2010 - 2009: |17 - 15| = 2$$

$$2011 - 2010: |13 - 17| = 4$$

$$\text{Total change for Mike Arwen} = 1 + 3 + 2 + 4 = 10$$

For Dave Backhand:

Differences between years are:

$$2008 - 2007: |14 - 12| = 2$$

$$2009 - 2008: |16 - 14| = 2$$

$$2010 - 2009: |15 - 16| = 1$$

$$2011 - 2010: |13 - 15| = 2$$

$$\text{Total change for Dave Backhand} = 2 + 2 + 1 + 2 = 7$$

For Ivan Right:

Differences between years are:

$$2008 - 2007: |10 - 14| = 4$$

$$2009 - 2008: |18 - 10| = 8$$

$$2010 - 2009: |18 - 18| = 0$$

$$2011 - 2010: |15 - 18| = 3$$

$$\text{Total change for Ivan Right} = 4 + 8 + 0 + 3 = 15$$

Based on my method, Dave Backhand should be the most consistent since his total change is the lowest at 7. Mike Arwen's total change is 10, and Ivan Right's is 15.



You've calculated the total changes for each player using your proposed method, which is a great first step. Now reflect on these numbers and consider what they might mean in the context of the organizers' decision. What could your next step be?

Since Dave Backhand has the lowest total change, which means his number of goals varied the least from year to year, that would make him seem like the most consistent player according to my method.



So for the organizers, I could say my measure of consistency is calculating the year-to-year goal difference, taking the absolute value, and adding those differences up for the total change.

Is there another measure I should think of, or should I just give them this one?



You have a measure that could work well for the organizers. Is there anything else you might want to consider when determining a player's consistency? What other aspects of the data might be worth looking into?

Oh, I think I got something. Maybe it's not just the changes that matter but also how many goals they score on average. Like, a player might have little changes but always score super low or super high. Could we also average the number of goals, and the most consistent player would have a small total change and a decent average?



So to calculate the average, I would add up all the goals for each player over the 5 years, then divide by 5, since there are 5 years. Then I could maybe combine this info with the total change somehow? What do you think?

You're definitely on to something by considering the average. How might understanding the average as well as the total change help the organizers in their decision for the most consistent player? What kind of relationship between these two pieces of information could be important?

Well, if we look at the total change and the average, we might be able to see who's consistent in terms of not just having a stable number of goals from year to year but also consistently contributing a good amount of goals overall. A player with a low total change and a high average might be seen as more consistently valuable to the team because they're reliable and also score a lot.



So maybe the relationship could be like this: A small total change is good for consistency, and a higher average is good for showing they contribute well. We could look for the player with the best balance of a low total change and a high average. Like, we wouldn't want someone who always scores very few goals but never changes, cause that's not as helpful for the team.

Maybe we could rank the players by both their total change and their average and see if someone stands out in both categories?

That sounds like a thoughtful way of approaching the issue. How would you go about ranking the players based on this approach? What specific steps would you take to compare the players using both total change and average goals?

Ok, I'm thinking that I could do a ranking for each category - the total change and the average goals.



First, let's find the average goals for each player:

For Mike Arwen:

Total goals from 2007 to 2011 =  $13 + 12 + 15 + 17 + 13 = 70$

Average goals =  $70/5 = 14$

For Dave Backhand:

Total goals from 2007 to 2011 =  $12 + 14 + 16 + 15 + 13 = 70$

Average goals =  $70/5 = 14$

For Ivan Right:

Total goals from 2007 to 2011 =  $14 + 10 + 18 + 18 + 15 = 75$

Average goals =  $75/5 = 15$

Now let's rank them in both categories. We already have the total changes as Mike Arwen (10), Dave Backhand (7), Ivan Right (15), with the lowest being the best for consistency.

For the average goals, the order from highest to lowest is Ivan Right (15), Mike Arwen (14), and Dave Backhand (14).

Now we combine the rankings:

- Dave Backhand has the lowest total change and a decent average, which is good.
- Ivan Right has the highest average but the highest total change, so that's less consistent.
- Mike Arwen is in the middle with both a medium total change and a decent average.

So, it looks like Dave Backhand might be the best choice for "The Most Consistent Player" since he has a good balance of a low total change and a decent average of goals. Is this the right way to think about it?

Considering all the calculations and comparisons you've made, what do you think the next step should be to reach a conclusion?

I think the next step would be to present this information to the organizers of the Premier League Federation. I would explain the two measures I used – total change and average goals – and show them the numbers. I would suggest that Dave Backhand should be awarded "The Most Consistent Player" based on his low total change in the number of goals over the five years and his decent scoring average, indicating his dependable performance.



Here's how I would rank them according to the measures:

1. Dave Backhand - Least total change in the number of goals (most consistent year-to-year) and a good average.
2. Mike Arwen - Middle total change and middle average goals (reliable but not as consistent as Dave).
3. Ivan Right - Highest average goals (so great contribution) but also the highest total change (less year-to-year consistency).

So according to my analysis, Dave Backhand is the most consistent. Should I do anything else, or is this good for the organizers?

It sounds like you've laid out a comprehensive analysis. With your reasoning and calculations, do you feel confident in your assessment? If so, what could be your final step with this information?

Yeah, I feel pretty good about it. I think the final step would be to write up a summary of my findings to give to the organizers. I'd tell them that Dave Backhand is the most consistent based on the year-to-year total change in goals and the average number of goals scored over the 5 years.



I'd also include the calculations for them to see how I got the numbers and make it clear what method I used so they can see it's fair.

So I think I'm done unless there's something I missed or if there's another way to look at the data. Am I good to go?

Based on your analysis and understanding, how do you feel about your solution? Do you think you have done everything that the organizers have asked for?

I think I've done what the organizers asked for. I came up with a method to find the most consistent player by looking at the total change in goals from year to year and the average goals scored over the 5 years. I calculated those for each player, and then I compared them to decide who is the most consistent. Dave Backhand appears to be the most consistent according to this method.



So yeah, I feel pretty confident about my solution, and I think it's thorough and fair based on the data they gave us. It should be what the organizers need to make their decision. If you think everything looks good, then I guess I'm all set!

Thinking about your process and results, could there be any additional steps to reinforce your findings, or have you considered all the necessary aspects to come to a conclusion?

Well, I used the total change and the average of goals scored, and that seems to have given us a clear answer. But if we wanted to be more thorough for the organizers, maybe we could think about other ways consistency could be measured, or like, use some more official math things I haven't learned yet? But with what we have, I'd say it looks like we've considered what's needed with the data we have. If the organizers want something more advanced, they might need to use statistics I'm not familiar with yet.



So unless there's another simple method or something else I can calculate with the numbers from the table, I guess I have considered everything I can think of for my conclusion. Are we good?

Given all the work you've completed, how do you feel about the steps you've taken? Do they align with the initial task, and have you addressed it fully with the methods you are familiar with?

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