SCHEMES

G'Day!

This is your math friend James. Today I am answering a question from Ollie about using math to fool people.

Are there math schemes?

I want to be careful here as it is not at all nice to fool people. But if an idea is expressed as a puzzle that will surprise and delight people, causing absolutely no harm to anyone, in any way, and you work to explain what is really going on right away, then, yes, math can be used to create scenarios that surprise and help people understand the power of math.

For example, imagine I wrote the following letter to one-thousand of my friends.

> Dear Friend:
>
> Can you help me with an experiment? Could you flip a coin and write back to me with the result? I predict you will flip a HEAD. Can you tell me if I am right or wrong?
>
> Thank you!
>
> James.

(Two side questions: Who has a thousand friends? Who writes letters nowadays?)

If you repeatedly flip a coin, about half the time you will get HEADS and about half the time you will get TAILS. So, I expect about half of my friends, that is, about 500 of them, to write with the news:

> Yes! I got HEADS..

I'd then write back just to those 500 or so people with another letter.

> Fabulous!
> Would you mind tossing the coin again?
> I predict you will get HEADS again. Am I right?

About half of those approximately 500 people will indeed get HEADS again. That is, about 250 people will write back saying that I am right a second time!

Then will come a third letter, just to those 250 or so people.

> Wow! Do you mind doing a third toss? I predict you will get TAILS this time. Am I right?

And about half those people, something like 125 of them, will say that I am right. And you can guess what I am going to do next.

(By the way: I will write back to all the people who say I got my prediction wrong, thanking them for their time.)

puzzle #1

I eat half a banana and pause.

I then eat half of what remains and pause. **How much of the banana have I now eaten?**

I then eat half of what still remains, and pause. **How much banana in total have I now eaten?**

I then eat half of what is still left, and pause. **Have I eaten the whole banana yet? How much have I eaten?**

If I follow this eating pattern, will I ever eat the whole banana?

So far, 125 people will have experienced me making correct predictions three times in a row. (Yes?)

I'll then write a letter to those 125 or so people with another prediction, and I will be right for about half of those friends, say 64 of them. And then another letter to those 64 with yet another prediction, and I will be right for about 32 of those folk. And one more letter and be right, yet again, for about 16.

At this point, those 16 friends will likely write back something along these lines:

Wow! You are blowing my mind!

You've correctly predicted my coin tosses SIX times in a row and that is amazing.

How are you doing it? How are you predicting the future so accurately?

And that is the time for me to explain that there is no magic here, that I actually started this experiment with 1000 friends and each person now is just one of the 16 people (just 16 out of 1000, not that many!) for whom I just happened to be right six times in a row.

And when I explain it this way, we all see that this is not actually exciting at all!

And this shows the trick of many "schemes." If you don't give someone the full story of what is going on, then what they experience can seem completely magical and too good to be true.

So, if you personally come across something that seems "too good to be true," ask:

What's the full story here?
What am I not being told about what's happening?

Math actually teaches you how to be a wise, thinking person, and how to help others if they seem fooled by something that is just too magical to be true.

So, here's a cheer to math good for one and all!

Thank you Ollie for this powerful message.

Check out **MATHICAL** for award-winning math books for middle-schoolers and teens, the YouTube channel **NUMBERPHILE** for math videos galore, and **MORE MATH!** for even more resources. Wowza!

Halves, and Halves of Halves, and so on, takes us to the famous Paradox of Zeno.

Do you have a math question for me to answer, or try to answer?

Write to me at the website.
Each week I'll pick a new question and give my thoughts on it!

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puzzle #2

Instead of predicting what toss of a coin people receive--HEADS or TAILS--what if I tried to predict people's roll of a single die--1, 2, 3, 4, 5, or 6.

If I want about 16 friends to experience me being correct with my predictions six times in a row, about how many letters to friends should I first write?

About the Author: Dr. James Tanton

The NMF Weekly is written by mathematician Dr. James Tanton as a resource for friends and fans of the 2021 National Math Festival.

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