MARK HARTMAN: See, there's no pattern. But what we do want to say is the top shows a large range around 50%, and the bottom-- boy, even that one sucks-- the bottom line shows a smaller range around 50%.

AUDIENCE: [INAUDIBLE]

MARK HARTMAN: Yeah, over the top. Top shows a large range around 50%. And I guess I'm not saying that it's around 50%. But it's not that at 75% to 25%, it's 50%. But on average, it's still showing an average of 50%.

But the spread of our measurements is pretty wide. It goes up to 75% and down to 25%. So the top shows a large range or spread around 50%. The bottom line shows a smaller range or a smaller spread around 50%.

Has anybody ever heard of this statistical measurement called a standard deviation? Probably not. That's a mathematical way of saying the average of these values is if you add them all up and divide by the total number. It's kind of like the average value. The standard deviation is a way of measuring how much do your values spread around that central value, around that average value.

So this is the observation that we're seeing. What was different about the first line versus the last line over here? Nicki?

AUDIENCE: More tosses.

MARK HARTMAN: We had more tosses. So I'm just going to fill you in on what we say this model-- what is the model to explain this observation. The model is that repeated measurements-- when we say repeated measurements-- wait a minute. I want to say this the right way.

Right. No, OK. So the model is if we have a repeated measurement, repeated measurements are closer to the actual value. If we do more measurements of something, we're more likely to have our answer be close to what the actual value is.

Now, this happens with things that have probabilities, like flipping coins, as well as collecting photons. Because if you took a picture of an object and you collected a certain number of photons, say, in five seconds, and then you collected photons in another five seconds, even if it was the same object, even if it was giving off the same amount of luminosity, you're going to collect a slightly different number of photons.

Let's summarize a little bit, and then I'm going to ask you guys a couple of questions, I think. So let's put down-- so this is our model, that if we make repeated measurements-- and that means either flipping coins more or collecting more photons in a single bin or more photons with our image.

We want to say that error bars-- this is kind of another definition. These error bars or uncertainties are an estimate of the range in which we'd find the actual value. Because there is a real measurement of the flux, but because we can't measure everything perfectly well-- we have to measure only the photons that we're getting-- we have to have an estimate of the range where the actual value would lie.

So OK, I'll get out of the way so you guys can write that down. Error bar is an estimate of the range in which we'd find the actual, real value, just like we saw up here. So this measurement would have a large-- or let's just say here, our range of 50% is about-- our range is 50% from the lowest value to the highest value.

Here, our range is 25%. Here, our range, from the lowest value to the highest value, 25-- that's 19%. And here, our range is 37 to 56, so that's about 19. Is that right-- 37, 47, 57, 19. So you can see that our range gets smaller as we make more measurements. In the same way, our error bars get smaller as we have more photons. We've measured things multiple times.