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How many balls are there in the urn at 12 o'clock?

Problem: Consider an urn of infinitely large size and an infinite collection of balls numbered 1,2,3 Perform the following experiment.

At 1 minute to 12 o'clock, balls numbered 1,2, . . . , 10 are placed in the urn and ball numbered 10 is withdrawn (assume this procedure takes no time). At 1/2 minute to 12 o'clock, balls numbered 11, 12, . . . , 20 are placed in the urn and ball numbered 20 is withdrawn. At 1/4 minute to 12 o'clock, balls numbered 21, 22, . . . , 30 are placed in the urn and ball numbered 30 is withdrawn and so on. How many balls will remain in the urn at 12 o'clock?

The answer trivially is infinite, because all those balls except the ones numbered $10n, n \geq 1$ will be there in the urn at 12 o'clock!

Now consider a slight variation of the problem. Repeat the same experiment with the condition that in the i th withdrawal, it is ball numbered i that is withdrawn. How many balls will remain in the urn this time at 12 o'clock?

The surprising though trivial answer is none! To see the truth of this, observe that for any $i \in N$, the i th ball will have been withdrawn at $(1/2)^{i-1}$ minutes to 12 o'clock!

We thus conclude from our analysis that the nature of selection of the ball to be withdrawn makes all the difference. This leads to the following non-trivial question: what will happen if the ball to be withdrawn is randomly selected? (Assume equal probability).

Keywords
 Random selection.

