1. Simulate the Reggie Jackson Problem 10 times. 
   Record your number of boxes needed to get the poster.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Number of boxes needed to get Reggie Jackson</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<td>2</td>
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<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

   Average Number of Boxes: $\bar{X} = 2.3$

1. Create a probability distribution table for the variable $X$ – the number of cereal boxes needed to obtain the first Reggie Jackson poster. Calculate probabilities for $X$ between 1 and 10, by using the geometric probability distribution function on the calculator: geompdf(p,n).

   $\begin{align*}
   X &= 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad 10 \\
   \text{Probability} &= \frac{3}{10} \quad \frac{2}{10} \quad .149 \quad .069 \quad .044 \quad .029 \quad .019 \quad .013 \quad .009
   \end{align*}$

2. Create a table for the cumulative distribution.

   $\begin{align*}
   X &= 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad 10 \\
   \text{Probability} &= \frac{3}{10} \quad \frac{5}{10} \quad .703 \quad .802 \quad .902 \quad .932 \quad .952 \quad .9835
   \end{align*}$
3. Using your pdf table and your knowledge of the mean of a random variable, find the mean number of boxes a person would have to buy to obtain a Reggie Jackson poster. (**This is only an approximation, since the probabilities of 11, 12, 13,... boxes are very, very small, we are not accounting for them.**)

\[ M_x = 2.82 \approx 3 \]

4. Using your mathematical intuition, on average, how many boxes do you think a person would have to buy to obtain the first Reggie Jackson poster? From this, what is the formula for the mean of a geometric random variable?

\[ M_x = 3 \]
\[ M_x = \frac{1}{p} \]
\[ M_x = \frac{1}{\frac{1}{3}} = 3 \]
5. Using your cdf table, what is the probability it takes more than 3 cereal boxes before getting the Reggie Jackson poster?

\[ P(X > 3) = 1 - 0.703 = 0.297 \]

\[ P(X = 1, 2, \text{ or } 3) \]

\[ P(X > 3) = \left( \frac{2}{3} \right) \left( \frac{2}{3} \right) \left( \frac{2}{3} \right) = 0.297 \]

\[ \left( \frac{2}{3} \right)^3 \]

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**The Geometric Setting**

1. Each observation falls into one of just two categories, which for convenience we call “success” or “failure.”
2. The observations are all independent.
3. The probability of a success, call it \( p \), is the same for each observation.
4. The variable of interest is the number of trials required to obtain the first success.

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**Rule for Calculating Geometric Probabilities**

If \( X \) has a geometric distribution with probability \( p \) of success and \( (1 - p) \) of failure on each observation, the possible values of \( X \) are 1, 2, 3, \ldots . If \( n \) is any one of these values, the probability that the first success occurs on the \( n \)th trial is

\[ P(X = n) = (1 - p)^{n-1} p \]
4. Using your mathematical intuition, on average, how many boxes do you think a person would have to buy to obtain the first Reggie Jackson poster? From this, what is the formula for the mean of a geometric random variable?

The Mean and Standard Deviation of a Geometric Random Variable

If $X$ is a geometric random variable with probability of success $p$ on each trial, then the mean, or expected value, of the random variable, that is, the expected number of trials required to get the first success, is $\mu = 1/p$. The variance of $X$ is $(1 - p)/p^2$.

$$\mu = \frac{1}{p} \quad \sigma^2_x = \frac{1-p}{p^2}$$

(Not on AP)

5. Using your cdf table, what is the probability it takes more than 3 cereal boxes before getting the Reggie Jackson poster?

$P(X > n)$

The probability that it takes more than $n$ trials to see the first success is

$$P(X > n) = (1 - p)^n$$