WIDGET DURABILITY TESTING

OBJECTIVE

A company you work at is manufacturing durable widgets. They are meant to sustain substantial falls. Imagine the company is in a building that has 100 stories. You have two widgets for testing the durability.. Your team is tasked with finding the highest floor from which you could throw a widget out the window and it doesn't break. You only have two widgets though, so you need to be judicious with how you use them - once a widget breaks, you can't use it anymore.

RULES

- In this scenario, widgets consistently break (or survive) if they are thrown from the same window. For example, if a widget is thrown from the 50^{th} floor and it doesn't break, then it won't ever break if thrown from the 50^{th} floor (or any floor below).
- Consequently, if a widget survives a toss from the 50^{th} floor, that means that it will always survive a throw from any floor underneath it.
- Most likely, if you come up with a solution, there is still a better one.
    - Part of the process of this solution is pushing yourself. If you arrive at a solution, iterate on it. Find a second solution that is better. A good benchmark is figuring out the worst case scenario; how many tosses would you need to make if the floor that widgets broke from was 50? 75? 99?

TASK

Explain to the class the process you used to discover a solution.
(Solution is below, since it fits better on one page)

SOLUTION

I started with a simple series of numbers in my head: going in pairs of ten for first widget, and then starting from one on the last floor it broke on to get to the floor, but it had a glaring flaw, the higher the potential floor it breaks on, the higher the number would be. The highest potential number of tries was 19 (count in tens to 100, and then count in ones starting from 91, if the floor is 99) I figured I could do better than this.

I started by subtracting the number of floors (x) by 1, keeping the number of drops balanced for all potential drops. To find out the maximum number of drops (and starting floor), I used the following (x = number of drops for the first widget, 100 = total number of floors):

$$x + (x - 1) + (x - 2) \dots + 1 = 100$$

Using the formula for the sum of consecutive integers:

$$x(x + 1) / 2 = 100$$
$$x^2 + x - 200 = 0$$

which can be solved with the quadratic formula:

$$x = (-1 + \sqrt{1 + 800}) / 2$$
$$x = 13.65$$

Taking the positive root results in 13.65, which will round to 14 for the sake of consistency.

Here are the floors visualized:

14, 27, 39, 50, 60, 69, 77, 84, 90, 95, 99, 100

As an example, Floor 27, would be the second drop, and would take 14 drops total assuming the second widget breaks at 26 (the first 2 drops are the first widget, breaking at 27, and the second widget would have 12 drops if it broke on the 26th floor)