

We first calculate the total number of possible drawings. To do this we calculate the number of ways to draw 5 numbers out of a hopper of 53 balls and 1 out of a hopper of 42 balls:

$$\begin{aligned} & \# \text{ of possible draws} = \\ (\# \text{ of ways to draw 1st 5}) \cdot (\# \text{ of ways to draw powerball}) = \end{aligned}$$

$$\binom{53}{5} \cdot \binom{42}{1} = \frac{53!}{(5!)(48!)} \cdot \frac{42!}{(1!)(41!)} =$$

$$\left(\frac{53 \cdot 52 \cdot 51 \cdot 50 \cdot 49 \cdot 48 \cdot 47 \dots}{(5 \cdot 4 \cdot 3 \cdot 2 \cdot 1)(48 \cdot 47 \dots)} \right) \cdot \left(\frac{42 \cdot 41 \cdot 40 \dots}{(1)(41 \cdot 40 \dots)} \right) =$$

$$\left(\frac{53 \cdot 52 \cdot 51 \cdot 50 \cdot 49}{120} \right) \cdot \left(\frac{42}{1} \right) = 1.20 * 10^8$$

In class we estimated this, saying $49 \approx 48 = 4 \cdot 12$ as:

$$\left(\frac{53 \cdot 52 \cdot 51 \cdot (5 \cdot 10) \cdot (12 \cdot 4)}{10 \cdot 12} \right) \cdot 42 =$$

$$53 \cdot 52 \cdot 51 \cdot 5 \cdot 4 \cdot 42 \approx 50^3 \cdot 20 \cdot 40 = 125000 \cdot 20 \cdot 40 = 1.00 * 10^8$$

These two numbers are roughly equal (in the sense of an athlete earning 120 million dollars is roughly the same as earning merely 100 million dollars)