

## The math behind The Hunger Games

The basic premise of the story is that there is a society in what used to be North America made up of a centralized capital and 12 outer districts. Seventy-four years ago the districts staged an uprising against the capital which was violently put down. As punishment for this transgression, every year each of the districts must send one boy and one girl to take part in the Hunger Games. This is a televised “contest” in which 24 children between the ages of 12 and 18 (inclusive) fight to the death until there is a sole survivor who is declared the winner.

Ignoring certain complications, each previous year that a kid’s name is not drawn her or his name appears one more time the next year.

### **The lottery probabilities.**

Suppose the parents in a given district gave birth to only 10 children, five boys and five girls, and that all of these kids were born at the same time. This would mean that they would all turn 12 at the same time and that all their names would go into the lottery at the same time.

1. What is the chance that a 12-year old girl would be chosen for the game? What about a boy?
2. What is the probability of being chosen when they turn 13? 14, 15, 16 17, and 18?
3. Graph your result (probability of being chosen versus age) to the above questions?
4. Describe your graph. Does it make sense?

Let's introduce one complication.

There is another way for children's names to appear more often in given drawings than merely getting older. The world of *HG* is one of near starvation for many of those residing in the districts. **One way to get more food is for a family to volunteer to have a child's name entered into the lottery a higher number of times.** That is, a family with a 13-year-old whose name would ordinarily appear in the drawing twice could enter the child's name more than two times in return for a higher portion of food.

5. Suppose the parents in district-12 gave birth to only 20 children, 10 boys and 10 girls, and that all of these kids were born at the same time. This would mean that they would all turn 12 at the same time and that all their names would go into the lottery at the same time. For Katniss' family, two major events happen: before she turned 14 (her family lost their livestock) and before she turned 16 (both her sister and mom were really sick). Both these events caused Katniss to enter her name into the lottery a higher number of times. By the time she reached 18 (if she makes it), her probability of being chosen for the HG is 75%. Give some possible probabilities for Katniss at every age from 12 to 18.

6. **Prisoner's dilemma.** Imagine two criminals arrested under the suspicion of having committed a crime together. However, the police do not have sufficient proof to convict them. The two prisoners are isolated from each other; the police visit each of them and offer a deal: they will receive a reduced sentence if they rat on their partner. If neither criminal accepts the offer, there is only enough evidence to convict each of them for 5 years. If only one criminal offers evidence, he goes to prison for 1 year and his partner will go to prison for 10 years. However if both criminals take the deal, each of them will get the maximum number of years, because the deals are null and void after enough evidence has been gathered to convict the criminals. Fill in the table below.

	Prisoner 1		
Prisoner 2		Stay Silent	Take Deal
	Stay Silent		
	Take Deal		

7. Back to HG. How do members of the coalition would even get any sleep, especially given that they slept near each other? This may seem like a strange question but the PD game can show that it isn't so strange. Make your own table similar to the PD table above considering the perspective of any given player versus everyone else in the game.

What if the other players don't sleep? If you don't either, then you will be tired and, perhaps, more vulnerable to better-rested contestants. But if you sleep while others are awake, any one of them can kill you in your sleep. Presumably, it's better to be tired than dead so you are under tremendous pressure to stay awake.


8. Now, we're going to test out as a class whether we are more likely to cooperate or think of ourselves.