

Dr. Chun's Numb3rs & Løgic

Birthday Problem



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Birthday Problem #1



- Ask Marilyn, Parade Magazine, (January 11, 1998), p. 8

"I was born on **Sep. 11**. When my wife went to the mall, I tagged along to take a random survey. I spoke with 100 people, and 28 gave me the cold shoulder. Of the remaining 72, no one shared **Sep. 11** as a birthday. What happened?"

- Charles L. Bailey Jr., Baldwinsville, N. Y.

- **Question**

How many people you need to have at a party so that there is a better-than-even chance that **at least one of them** will share the **same birthday as yours**?



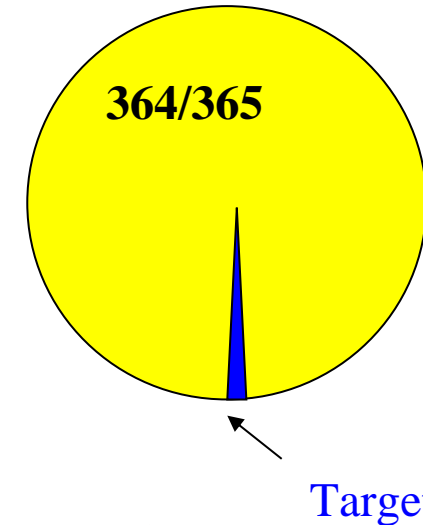


- Same birthday as yours (September 11)?

- Spin the dart board

$$P[\text{Hit the target}] = 1/365$$

$$P[\text{Miss the target}] = 364/365$$



$$P[\text{All of } N \text{ people miss the target}] = (364/365)^N$$

$$P[\text{At least one of them hit the target}] = 1 - (364/365)^N$$

- If $N = 253$, $P[\text{At least one}] = 50.0477\%$

Birthday Problem #2



- Ask Marilyn," *Parade Magazine*, (August 3, 1997), p. 15

"They say it is a well-established fact that, in any randomly chosen group of 50 people, it is virtually certain that two will have birthdays **on the same date**. Since there are **365 days** in a year, I can't understand why this is the case. Can you explain this phenomenon?"

- Robert Shearn, Loleta, Calif.

- Question

How many people you need to have at a party so that there is a better-than-even chance that **at least two of them** will share the **same birthday**?





- Pick a card from a deck of 365 cards

001 002 003 004 005 ... 363 364 365

- $P[\text{None of } N \text{ people pick the same number}]$

$$= (365/365) * (364/365) * (363/365) * \dots$$

$$= 365! / (365 - N)! / 365^N$$

$$= \text{Permutation}(365, N) / 365^N$$

- $P[\text{At least one couple}]$

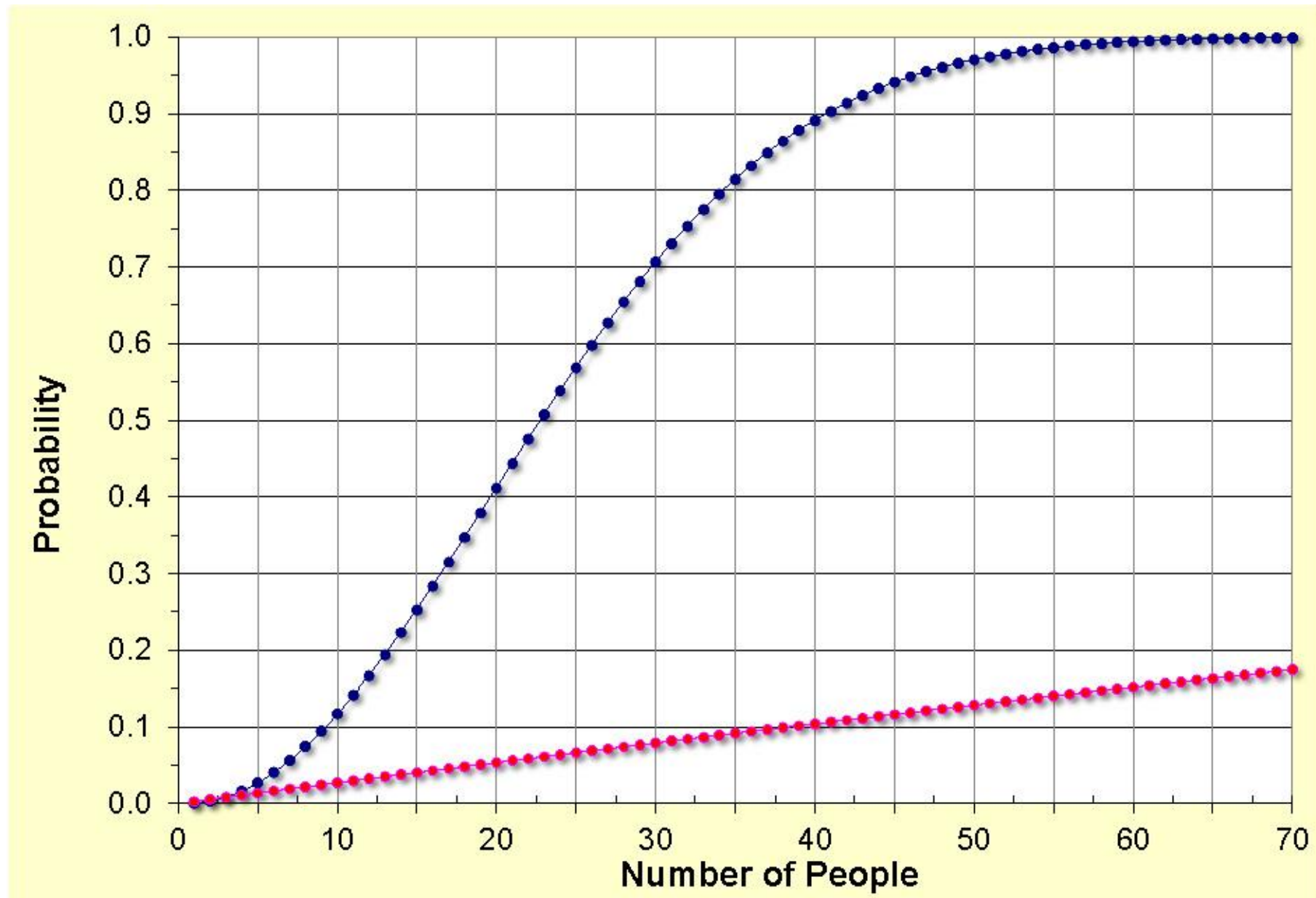
$$= 1 - P[\text{None}]$$

$$= 1 - \text{Permutation}(365, N) / 365^N$$

- If $N = 23$, $P[\text{At least one couple}] = 50.730\%$



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Breaking News!



In reality, the birthdates are not **uniformly** distributed and, in such a case, it may take **less than** 23 people...

For example, if your father is a **professor**, chances are...

You were born in **summer** or in **winter**...



OMG! My kids were born on **May 21** and **December 21**. Why?

Perfect Family Planning !!!

I was a **graduate student** and they were born **after** my **final exams**...

Birthday Problem #3



- **Question #1**

“How many randomly chosen people must I gather to be reasonably sure to have at least one person born in **every day of the year**, from January 1 to December 31? The year of birth doesn't count.”



- **Question #2**

How many **dice** should be rolled together so that you could have **all the six numbers**?

3 5 3 1 5 2 2 1 4 2 3 5 2 4 6



- P[Birthday cake everyday]

0.50 with $N = 2,287$ people

0.99 with $N = 3,828$ people

$E[N] = 2364.65$ people

- P[All the six numbers] How many dice?

0.5139 with $N = 13$ dice

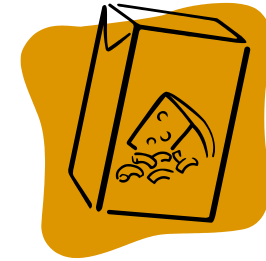
0.9915 with $N = 36$ dice

$$\begin{aligned} E[N] &= 6/6 + 6/5 + 6/4 + 6/3 + 6/2 + 6/1 \\ &= 14.70 \text{ dice} \end{aligned}$$



- **Question #3** (Coupon Collector's Problem)

If a cereal box has one of m random baseball cards, how many cereal boxes do you need to buy to get a complete set of the baseball cards?



- **Question #4**: Ask Marilyn, (Sep. 12, 1993, p. 8.)

"Let's say a company sells candy bars with basketball team names imprinted on the bar, and there are 27 teams. If I can't open the wrappers beforehand, how many candy bars would I have to buy to make sure I have a full set?"

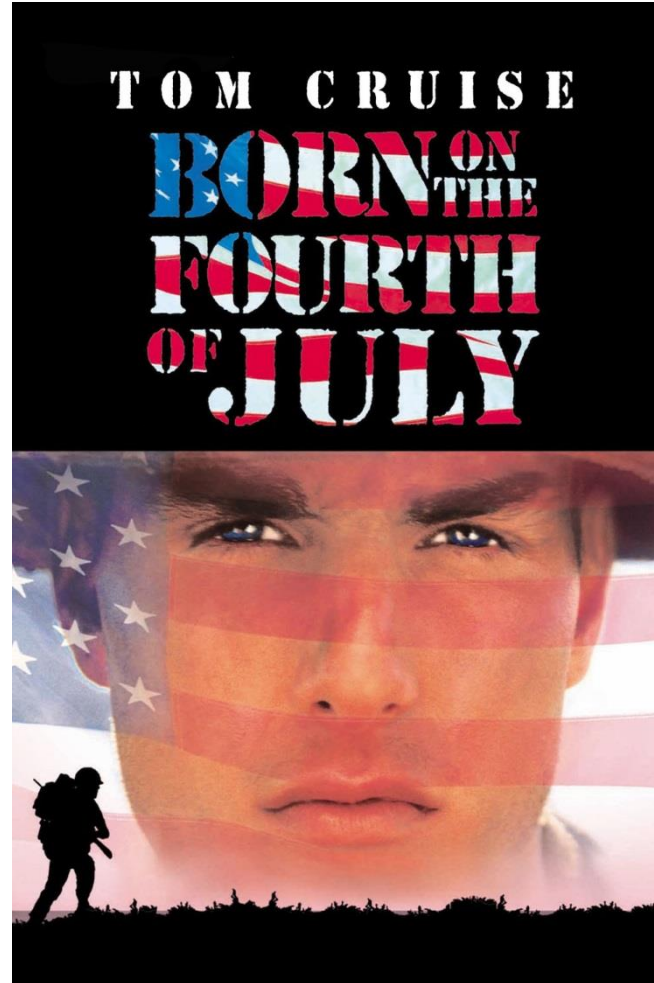
- Michael Rose, Salona, Pa."

Movie Trivia



Paralyzed in the **Vietnam war**, he becomes an anti-war and pro-human rights political activist after feeling betrayed by the country he fought for.

Born on the Fourth of July (1989)



Paralyzed in the **Vietnam war**, he becomes an anti-war and pro-human rights political activist after feeling betrayed by the country he fought for.