Example: Polling Problem

- you have a referendum & a fraction p of the pop^n is going to vote 'Yes'

Problem: conduct a poll & estimate $p \rightarrow$ how many to poll?
- we could do the whole pop^n but that's just conducting the referendum.

- randomly sample the pop^n uniformly
- i'th person returns $X_i = \begin{cases} 1 & \text{'Yes'} \\ 0 & \text{'No'} \end{cases}$
- note $\mathbb{E}[X_i] = p$ (unknown).
- $\bar{X}_n = \frac{X_1 + X_2 + \cdots + X_n}{n}$ = fraction of 'Yes' in the sample.

- You're boss wants you to predict p but there will always be some error if $n < N_{pop}$.
- so he asks for an estimate $\bar{c}$ a small error. Say,

$$|\bar{X}_n - p| < 0.01 \quad (1\%)$$

→ he want's this guaranteed!

- let's say you sample $n = 10{,}000$
- but you can't really meet the guarantee!
  - say you accidently polled every who say 'No'
    ⇒ there is a $(1-p)^n$ chance of this happening
  → you can't give a guarantee in absolute terms of an error. that it will be small
- instead you can offer this:

> I cannot guarantee $\bar{c}$ certainty the error will be small, but, I can guarantee that the error will be small $\bar{c}$ high probability.