AMS 131, 29 Jul 19

(1)

this time: intro case study

next time: foundations

read: as in syllabus

n = # children

as n ↑, P(1 or more T-G kids) ↑

P(A)

↑ the probability of A

A is a set ←

or A is a true/false statement (proposition)

history

3800 BC Mesopotamia ← 6000 years ago

probability ↔ quantification of uncertainty

incomplete information

1650: Pascal & Fermat (classical)

gambling 8000 years

10.04

population
all deer living at UCSC on 1 Aug 2019

sample

sample size

1 = yes
0 = no

disease?

N = 1850

pop. size

~~no~~ 0
~~no~~ 0
~~yes~~ 1
⋮
~~no~~ 0

qualitative

quantitative

at random

1938

n =

n ↑ good data ⇒ uncertainty about θ ↓

population mean $\theta = p = ?$
unknown

to decrease your uncertainty, get more good data

variables

p or k

subjects of study

n or N

all datasets

good sample = sample representative of pop.

similar to, in all relevant ways

Q: how achieve representativeness?

simple A: at random

with replacement

without replacement

SRS

simple random sampling

IID (independent identically distributed)

more informative than IID

but more complicated math

$n = 1 \leftrightarrow$ IID = SRS

$n = N \leftrightarrow$ no uncertainty about θ

$n \ll N \leftrightarrow$ IID $\doteq$ SRS

analyze IID, do SRS

$\ll$ is a lot smaller than

N 200,000,000

n 1,000

$\begin{bmatrix} 1 \\ 2 \\ 7 \end{bmatrix}$ IID, at random $\begin{bmatrix} Y_1 \end{bmatrix}$ $n = 1$

$P(\underline{Y_1 \text{ is odd}}) = \frac{2}{3}$

equally-likely model $\boxed{ELM}$ = $\frac{\#\text{ "ways" favorable to}}{\text{total \# of "ways"}}$

(Pascal - Fermat)

if all ways experiment can come out can be enumerated so that no reason one favored over another $\leftrightarrow$ <u>elemental</u> <u>outcomes</u>

(EOs)

$$P(A) = \frac{\#\ \text{EOs favorable to } A}{\#\ \text{EOs}}$$

possible # T-5 bodies
0
1
2
3
4
5

if ELM

$P(\text{1 or more T-5}) = \frac{5}{6}$

ELM 5/6

$\boxed{\text{math}}$ If A then B

but ~~ELM~~ $\cancel{5/6}$

3 types of probability

① Classical	ELM usually doesn't apply
② Frequentist	(1850) John Venn
③ Bayesian	(1750) Rev. Thomas Bayes

$P(\text{red}) = \frac{18}{38}$

roulette

ELM ?

yes

0	green
00	
1	red
2	black
3	red
⋮	⋮
36	black

Eo/s

spin #	outcome	cumulative % red so far
1	red	100%
2	~~green~~ not red	50%
3	red	67%
4	~~black~~ not red	50%
⋮	⋮	⋮

frequentist

in limit converge to $\frac{18}{38}$

(10:55)

$$P(A \text{ or } B) \stackrel{?}{=} P(A) \; ? \; P(B)$$

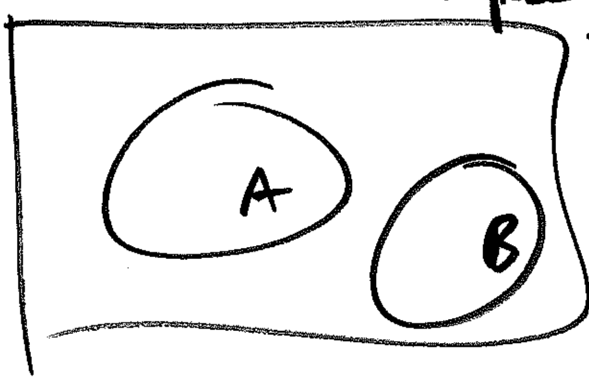
$$P(A) \;\; ?, \;\; P(\text{not } A)$$

$$P(A \text{ and } B) \stackrel{?}{=} P(A) \; ? \; P(B)$$

special case: no overlap: A, B

mutually exclusive

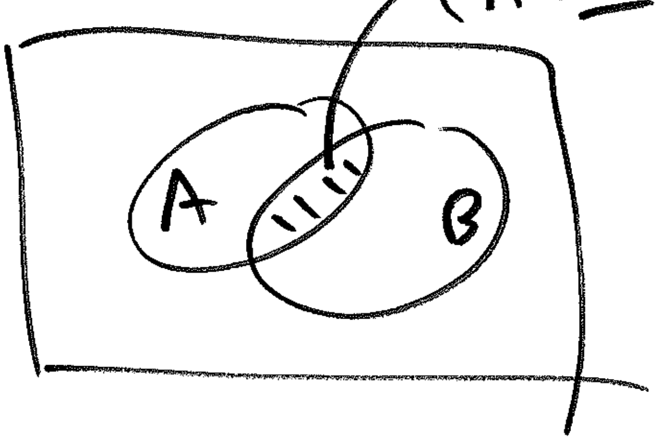
all possibilities



$$P(A \text{ or } B) = P(A) + P(B)$$

(A and B)

general rule for OR



$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

for any A, $\underset{(0\%)}{0} \leq P(A) \leq \underset{(100\%)}{1}$

$P(A) = 0 \leftrightarrow A$ is false

$P(A) = 1 \leftrightarrow A$ is true