2

5.1 PROBABILITY 11/13/2023

PROBABILITY - a measure of chance

PROB NOTATION - P of A

PROB FOUND - f/n (# of desired / # of total results)

- Fractions (reduced), decimals, % = all good

$P(\text{str}) = \frac{\#F}{n} = 1/2$ ML

$0 \leq P \leq 1$ Prob = 1 = certain

= 0 = impossible

* # and word "highly likely, highly unlikely"

P(X)

P(1) = 1/6

6/6 - 1/6 = 5/6

COMPLEMENT - probably not the event $P(\bar{A})$

$P(A) + P(\bar{A}) = 1$

$P(\bar{A}) = 1 - P(A)$

Guinea pig EXAMPLE:

P(pure white) + P(not pure white) = 1

P(not pure white) = 1 - P(pure white

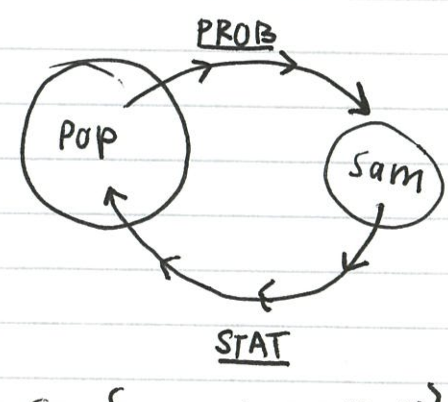
PROB VS. STAT

Stats - sample is known

- draw conclusions about the population

Prob - population is known

- likelihood of sample



ODD - type of probability

Favorable : unfavorable (1:1, 100:1, 1:5)

↳ $P \frac{100}{101} \approx C$

S = { ⚀, ⚁, ⚂, ⚃, ⚄, ⚅ }

LOL #s - law of large #s

- fallacy of a short run $ $ $ /// $ //////////

- real life ≈ theoretical probability (in the long term)

Sample space - S = {the set of all possible outcomes}

coin S = {heads, tails} 2 coins: S = {...

PROBABILITY – COMPOUND EVENTS 11/15

↓

2 or more events happening together

$P(A \text{ and } B) = P(A) \times P(B)$ ← ind / dep

$P(5,5) = P(5) \times P(5) = 1/36 \approx 0.027$ highly unlikely
$\quad\quad\quad 1/6 \quad\quad 1/6$

P(Ace and Ace) ← Replace vs. DO NOT Replace

Replace: $4/52 \times 4/52 = 16/2704 = 1/169 = 0.0059$
0.59%
highly unlikely

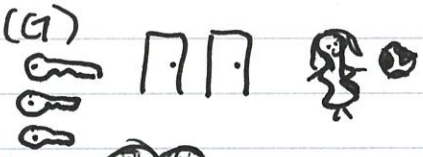
DO Not Replace: $4/52 \cdot 3/51 = 12/2652 = 0.0045$
0.45%
even highly unlikely ↑

dep

$P(A, B) = P(A) \cdot P(B|A)$

P(UGLY) = $1/3 \times 1/2 = 1/6 = 0.1667 = 16.67\%$ ← unlikely

P(B) × P(G)



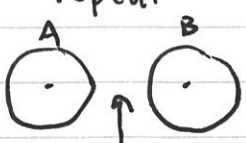
* Professor Jackson problem on slides similar to quiz

P(A or B)  = P(A) + P(B)

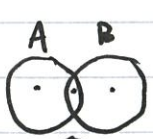
P(king or Ace) = P(K) + P(A)
$4/52 + 4/52 = 8/52 = 0.1538 = 15.38\%$ unlikely

P(♦ or king) = P(K) + P(♦) =
$4/52 + 13/52 = 17/52 = 0.3269 = 32.69\%$ mod. unlikely
K♦ → repeat $-1/52 = 16/52 = 30.77\%$
0.3077

mutually exclusive = non disjoint



P(A or B) = P(A) + P(B)



P(A or B) = P(A) + P(B) − P(A and B)

RANDOM VARIABLES VIDEO 11/17/23

REVIEW:

A and B → independent

$P(A \text{ and } B) = P(A) \times P(B)$

0.8697 " "

Yes! — 87% Living / 13% Dying ↓

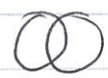
No!

∃xS

↑ there is no sample space

no over lap

no goals



P(UGLY)

$P(\$\$\$\$\$) = \frac{1}{25}^5 = \frac{5}{25} \times \frac{4}{24} \times \frac{3}{23} \times \frac{2}{22} \times \frac{1}{21}$

(\$|\$\$) (\$|\$) (\$|\$\$) (\$/\$\$\$\$) (\$/\$\$\$)

SOCKS:

BLACK: 8

BROWN: 7

BLUE: 6

GREEN: 4

GRAY: 4

RED: 3

PURPLE: 1

(Blk, Blk)

$8/33 \times 7/32 = 0.0530$

5.3%

(Brwn, Brwn)

$7/33 \ast 6/32 = 0.0398$

3.98%

dependent

(Blu, Blu)

$6/33 \times 5/32 = 0.0284$

2.84%

unit 4

5.2 COMPOUND EVENTS 11/28/23

Events A and B are independent: if $P(A) = P(A|B)$ ← A given B

HW PROBLEMS:

Medical Tests ~ has a 2-way table

P(+| condition present) $\frac{110}{130} \rightarrow \frac{11}{13}$ highly likely

P(-| condition present) $\frac{20}{130} \rightarrow \frac{2}{13}$ pretty unlikely

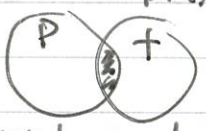
↳ false negative test

P(-| condition absent) $\frac{50}{70} \rightarrow \frac{5}{7}$ highly likely

P(+| condition absent) $\frac{20}{70} \rightarrow \frac{2}{7}$ pretty unlikely

↳ false positive

P(condition present and +) $\frac{110}{200} \rightarrow \frac{11}{20}$ mod. likely



P(present and −) $\frac{20}{200} \rightarrow \frac{1}{10}$ highly unlikely

Poison Ivy ~ 3 by 2 2 Way table

$P(N) = \frac{470}{1000}$ - 0.47 moderately unlikely

$P(N|W)$ $\frac{420}{500} \rightarrow \frac{42}{50}$ pretty likely

$P(N) = P(N|W)$

$0.47 \neq 0.84$ NOT independent

$P(S|A)$ $\frac{120}{500}$ 0.24 moderately unlikely

$P(N \text{ and } W)$ $\frac{420}{1000} = 0.42$ moderately unlikely

$P(N \text{ or } W)$ $\frac{470}{1000} + \frac{390}{1000} = \frac{860}{1000}$

0.86

pretty likely

4.3 STUDY GUIDE QUESTIONS 11/30/21

1. pg 177-184
2. When the outcomes are equally likely, how do we find P(A)?
   $\frac{\text{number of outcomes favorable to event A}}{\text{Number of outcomes in the sample space}} = P(A)$
3. Identify the limitation to the approach in #2?
   more complicated / takes longer
4. A visual display of outcomes made of a series of activities D
   c) a tree diagram
5. Although most of our class hasn't registered for University coursework what complications might exist in the tree diagram of course options Figure 4-6?
   - 12 possible schedules is a lot for each student
   - jobs, not many time options, prerequisite, sleep,
6. Compare and contrast the tennis match tree diagram w/ its sample space on page 171.
   - All include a start and 1st match
   - each adds another match w/ increases the amount of wins and losses
7. Write and calculate eleven factorial
   11! $11 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 39916800$
8. When does 0 = 1?
   factorials $1! = 1 \times 0$ $0! = 0$
9. (T)/F The order of items is not important w/ combinations
10. Match:
    - Combinations — $n!/(n-r)!$
    - Permutations — $n!/r!(n-r)!$
11. In Example 13 about political science class books, why do they compute the number of combination?

EDPUZZLE NOTES : PROBABILITY : RULES + PATTERNS (RAJH COURSE

pareidolia -  ← face

PROBABILITY

1. Empirical probability — what we observe in actual data
   - has uncertainty due to small sample
2. Theoretical probability — ideal / how we can't directly see ←

estimates...

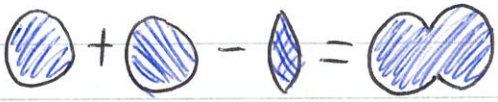
ADDITION RULE

Mutually Exclusive = 0

P(Red or Purple) =
P(Red) + P(purple)
P(A or B) = P(A) + P(B)

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

NOT mutually exclusive



MULTIPLICATION RULE

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

~~and~~ or ~~and~~

independent — probability of one event occurring is not changed by if the second event occurs or not

conditional probability = $P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$

JIMMY VOLVANO? VIDEO 12/04/23

1. LAUGH
2. think 
3. have your emotions ~~#~~ moved to tear
   → FEEL/ care about something
   → have a passion

Ralph Waldo Emerson - "nothing great comes without enthusiasm"