Math 110
Winter 2021
Lecture 9

Odds vs Probabilities

Express Prob: 3-decimals, reduced fraction, or Scientific Notation.

Express odds: using : notation

$a : b$

a: # of times E happens

b: # of times $\overline{E}$ happens.

I tossed a coin 100 times, and landed 65 Tails.

$P(\text{Tail}) = \frac{65}{100} = \frac{13}{20}$, odds for tails $65 : 35$

65 Tails, 35 tails

65 : 35 Math 1: Enter

13 : 7

odds for event E are $a : b$

a: # times E happens

b: # times $\overline{E}$ happens

A standard deck of playing cards

52 Cards, 26 Red, 12 Face, 4 Aces.

Find odds to draw

1) Red Card 26 Red : 26 $\overline{\text{Red}}$ $\Rightarrow$ 1:1

2) Face Card 12 Face : 40 $\overline{\text{Face}}$ $\Rightarrow$ 3:10

3) Ace Card 4 Aces : 48 $\overline{\text{Aces}}$ $\Rightarrow$ 1:12

4) Ace or Face $4 + 12$ → 16 : 36 $\Rightarrow$ 4:9

Odds for event E $\Rightarrow$ a:b

Odds against event E $\Rightarrow$ b:a

If odds for event E are a:b, then

$$P(E) = \frac{a}{a+b} \quad \text{i.} \quad P(\overline{E}) = \frac{b}{a+b}$$

ex: 50 Shots in a basketball game was selected,
28 were made shots, 22 were missed shots.

Odds to make shots 28:22 $\Rightarrow$ 14:11

$$P(\text{Make}) = \frac{14}{14+11} = \frac{14}{25} \qquad P(\overline{\text{Make}}) = \frac{11}{14+11} = \frac{11}{25}$$

Odds for a certain game are 4:21.

1) odds against $\Rightarrow$ 21 : 4

2) $P(E) = \frac{4}{4+21} = \frac{4}{25}$

3) $P(\overline{E}) = \frac{21}{4+21} = \frac{21}{25}$

odds are $a : b$

a: \$ bet

b: \$ Net win.

Odds for Lakers to win championship this year are 7:2

\$7 bet $\Rightarrow$ \$2 Net return

\$70 bet $\Rightarrow$ \$20 Net return

How much do you need to bet if you want your net return to be \$500?

$$\frac{\$7 \text{ bet}}{\$2 \text{ Net}} = \frac{\$x \text{ bet}}{\$500 \text{ Net}}$$

$$\frac{7}{2} = \frac{x}{500}$$

$$2x = 7(500)$$

$$x = \frac{7(500)}{2}$$

\$1750

$x = \$1750$

If $P(E)$ is given, then

the odds for event E are $\frac{P(E)}{P(\bar{E})}$, simplify, express final answer in $a:b$ Notation

ex: Suppose $P(E) = .6$

$P(\bar{E}) = .4$

odds for event E are $\frac{.6}{.4} \Rightarrow \frac{3}{2}$

$\boxed{3:2}$

$P(\text{Passing this class}) = .7$

$P(\text{pass}) = .7$

$P(\overline{\text{Pass}}) = .3$

odds for passing are $\frac{.7}{.3} \Rightarrow 7:3$

10 students

7 pass 3 $\overline{\text{Pass}}$

Odds for certain game are 3:220

How much do I need to bet make $990 in net return?

$$\frac{\$3 \text{ bet}}{\$220 \text{ Net}} = \frac{\$x \text{ bet}}{\$990 \text{ Net}} \qquad \frac{3}{220} = \frac{x}{990}$$

$$220x = 3(990)$$

$$x = \frac{3(990)}{220}$$

$13.50

Counting

Toss a Coin once ⇒ H or T 2 outcomes

Toss a Coin twice ⇒ HH HT TH TT 4 outcomes

$2 \cdot 2 = 4$

Toss a Coin once,

If Heads, Toss again HH HT

If Tails, Roll a die T1 T2 T3 T4 T5 T6

8 outcomes

Choose a passcode for ATM card

You need 4 digits

with repetition $10 \quad 10 \quad 10 \quad 10$

$= 10,000$

No repetition $10 \quad 9 \quad 8 \quad 7$

$= 5040$

Choose a letter, then 3 digits, then choose another letter. Letters are case sensitive, No repetition for Letters or digits. $52 \cdot 10 \cdot 9 \cdot 8 \cdot 51$

$= 1,909,440$

5 people, Allen, Bill, Carol, David, Ed

Select 2 of them

AB	AC	AD	AE
~~BA~~	BC	BD	BE
~~CA~~	~~CB~~	CD	CE
~~DA~~	~~DB~~	~~DC~~	DE
~~EA~~	~~EB~~	~~EC~~	~~ED~~

$5 \cdot 4 = 20$ outcomes

If order does not matter, 10 ways

$_5C_2$

items select

No replacement

Order does not matter

5 Math PRB $_nC_r$ 2 Enter

12 first-graders are part of basketball team. teacher needs 5 to start the game. How many ways can this be done?

$$_{12}C_5 = 792$$

CA Supper Lotto

Select 5 Numbers from 1 to 48,

Select 1 mega number from 1 to 24.

$$_{48}C_5 \cdot {}_{24}C_1 = 41,095,296$$

A Standard deck of playing Cards.

52 Cards 4 Aces.

Draw 2 Cards, No replacement, order does not matter.

1) How many ways can this be done?

$$_{52}C_2 = 1326$$

2) How many ways can we draw 2 Aces?

$$_{4}C_2 = 6$$

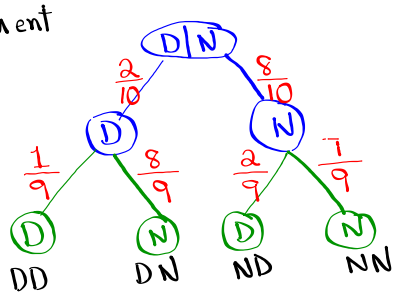
3) $P(\text{2 Aces}) = \frac{{}_4C_2}{{}_{52}C_2} = \frac{6}{1326} = \frac{1}{221}$

odds to draw 2 Aces are 1:220 Net

bet $1 $220

odds against drawing 2 Aces are 220:1

A box has 2 Dimes, 8 Nickels. Draw 2 Coins No replacement



$P(20¢) = P(DD) = \frac{2}{10} \cdot \frac{1}{9} = \boxed{\frac{2}{90}}$

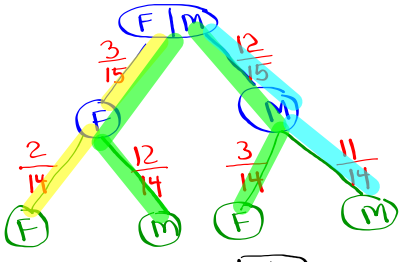
$P(15¢) = P(DN \text{ or } ND) = \frac{2}{10} \cdot \frac{8}{9} + \frac{8}{10} \cdot \frac{2}{9} = \boxed{\frac{32}{90}}$

$P(10¢) = P(NN) = \frac{8}{10} \cdot \frac{7}{9} = \boxed{\frac{56}{90}}$

Total ¢	P(Total ¢)
20	2/90
15	32/90
10	56/90

Clear all lists
Total ¢ → L1, P(Total ¢) → L2
use L1 & L2 to Find
$\bar{x} = 12$ S = blank $n = 1$

3 Females, 12 Males, Select 2 people



$P(2 \text{ Females}) = \frac{3}{15} \cdot \frac{2}{14} = \boxed{\frac{6}{210}}$

$P(1 \text{ Female}) = \frac{3}{15} \cdot \frac{12}{14} + \frac{12}{15} \cdot \frac{3}{14} = \boxed{\frac{72}{210}}$

$P(0 \text{ Females}) = \frac{12}{15} \cdot \frac{11}{14} = \boxed{\frac{132}{210}}$

# Females	P(# Females)
2	6/210
1	72/210
0	132/210

Females → L1
P(# Females) → L2
use L1 & L2 to Find
$\bar{x} = .4$ S = blank $n = 1$

$P(A) = .6$ $P(B) = .7$ $P(A \text{ and } B) = .45$

1) $P(\bar{A}) = 1 - .6$
$= .4$

2) $P(A \text{ or } B)$
$= P(A) + P(B) - P(A \text{ and } B)$
$= .6 + .7 - .45$
$= .85$

3) Draw Venn Diagram

4) $P(B|A) = \dfrac{P(A \text{ and } B)}{P(A)}$
$= \dfrac{.45}{.6} = .75$

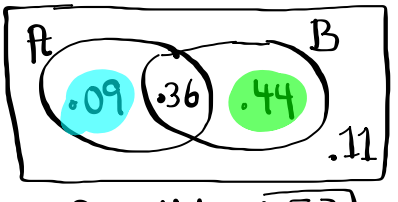
$P(A) = .45$ $P(B) = .8$ A & B are independent events

1) $P(\bar{B}) = 1 - P(B)$
$= .2$

2) $P(A \text{ and } B) = P(A) \cdot P(B)$
$= (.45)(.8) = .36$

3) $P(A \text{ or } B)$
$= P(A) + P(B) - P(A \text{ and } B)$
$= .45 + .8 - .36 = .89$

4) $P(A \text{ only or } B \text{ only})$



$= .09 + .44 = .53$

4 females & 16 males, Select 5 people

1) How many ways can this be done?

$$_{20}C_5 = 15504$$

2) How many ways can we select 2F & 3M

$$_4C_2 \cdot {}_{16}C_3 = 3360$$

3) $P(2F \& 3M) = \dfrac{{}_4C_2 \cdot {}_{16}C_3}{{}_{20}C_5} = \dfrac{3360}{15504}$

3360 ÷ 15504 Math 1 Enter = $\dfrac{70}{323}$

WORK on SG 13 & 14

Watch video on Prob. with at least 1.