Probability & stats – 2 lectures

Remedial - session

↳ clear confusions

Assumption: gone through regular classes

Next class onwards

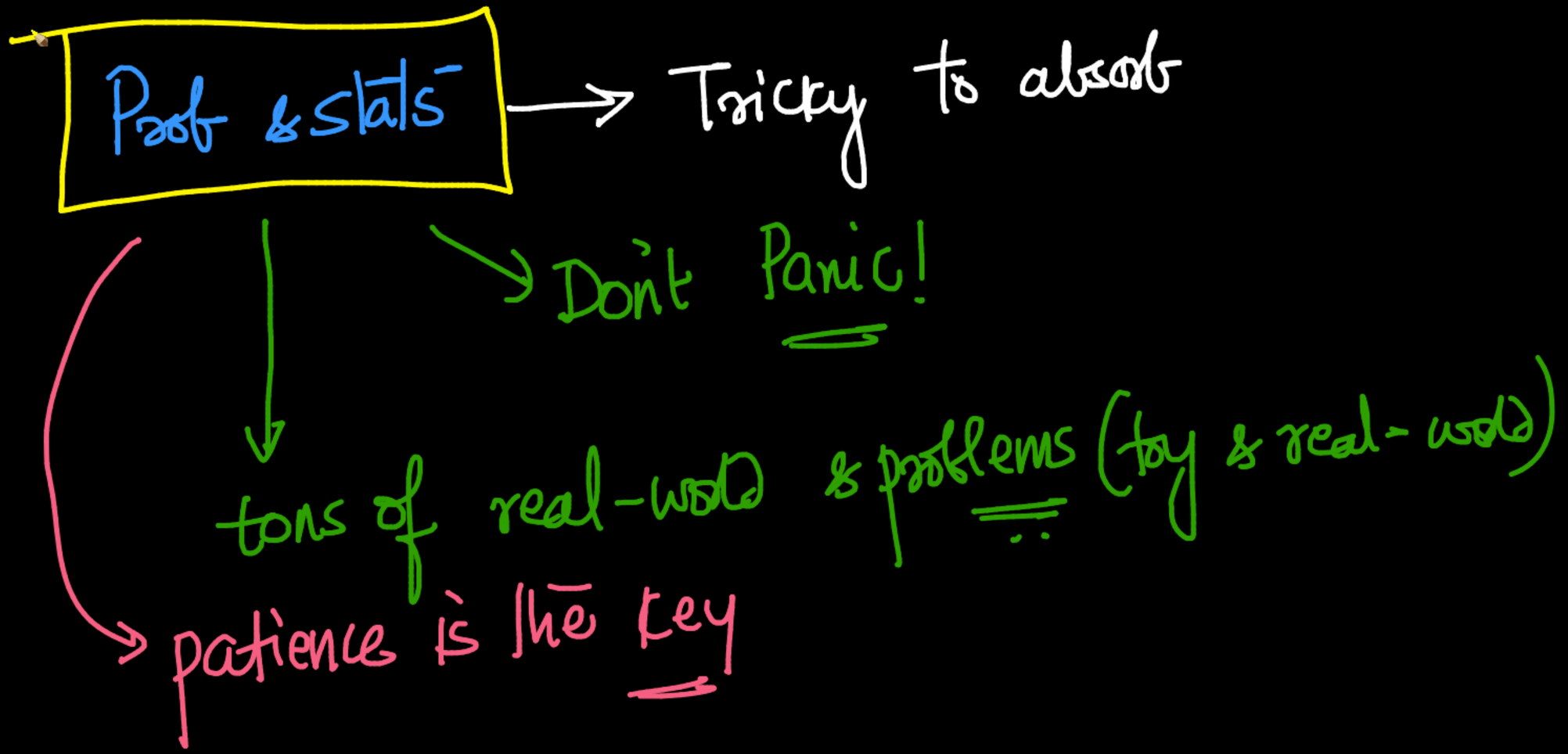
→ any left-over topics

→ regular - topics

} → primary instructor

{ TTS → time being

{ MWF → 4-5 classes



Topics: (lots of examples & problems)

1. Joint & conditional probability
2. Independent events
3. Mutually exclusive & exhaustive events
6. Bayes Theorem & examples
7. Descreptive stats → Open

Operations

1. Chat window → end of each topic
   ↳ context
2. out of context → Q&A (@ end)
   Unmute (Audio)
3. participate in problem-solving → chat-

Read Eqns:

Poetry

$P(M_1 \text{ and } S) = P(M_1 \cap S) = P(M_1, S)$ — Joint Probability

(1000) U: Universe of all covid patients

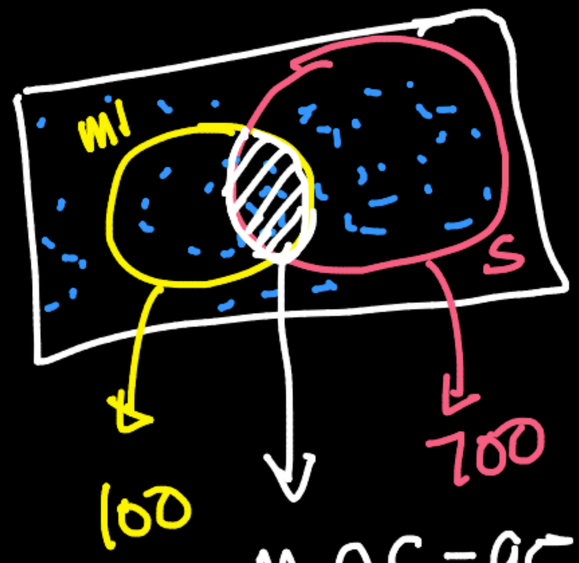
(100) M_1: all patients administered medicine-1

(700) S: patient survived

$P(M_1) = 0.1 = 10\% = 100/1000$

$P(S) = 0.7 = \frac{700}{1000}$

$P(M_1 \cap S) = 95/1000 = 0.095$



joint prob

↓

2 or more events jointly occuring together

{ Set-based Venn-diagrams ⟶ Alt-
↳ helpful

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DSML Advanced : Probability & Statistics Remedial -1 | Lecture

GEOMRTT

$$P(M_1) + P(S) - P(M \cup S)$$

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00:20:47

8 / 8

Srikanth Varma Chekuri (You)

People 22

Chat

Questions

Chat

Notify me about Nothing

Saurav Kumar To: Everyone 9:15 pm

Pin a message

keshav kumar To: Me 9:16 pm
intersection of m1 and S

Tai Rakesh To: Me 9:16 pm
p(m1)+p(s)-p(m^s)

Prabhakar Patra To: Me 9:16 pm
.07

Tai Rakesh To: Me 9:19 pm
0.095

Adyashree Mahapatra To: Me 9:19 pm
0.095

Tai Rakesh To: Me 9:19 pm
95/1000

Adyashree Mahapatra To: Me 9:19 pm
95/1000

Deepak Mittal To: Me 9:20 pm
P(M) + P(S) - P(M U S)

Srujana Kata To: Me 9:20 pm
0

keshav kumar To: Me 9:20 pm
0.1 * 0.95

Yes No

To: Everyone Enable/Disable Chat

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Start Doubt Session

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GEOMRTT

(Q) Throw a dice $\{1,2,3,4,5,6\}$ ← Space

A: even number on a throw → $\{2,4,6\}$

B: prime number on a throw → $\{2,3,5\}$

$$P(A \text{ and } B) = \frac{1}{6}$$

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(Q) Throw a dice → {1,2,3,4,5,6}

A: even number ← {2,4,6}

B: prime number ← {2,3,5}

C: NOT {2,3,4} ← {1,5,6}

$$P(\overbrace{A \text{ and } B \text{ and } C}) = \frac{0}{6} = 0$$

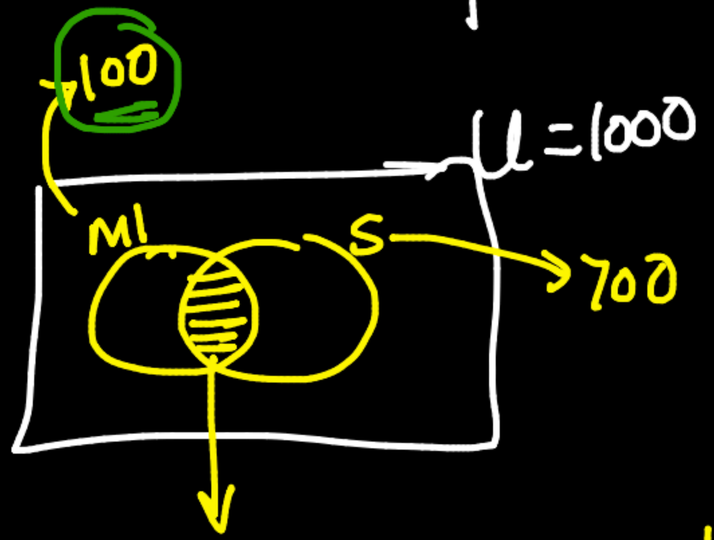
$P(S|M_1) =$

Same covid example:

M1: patient admin M1

S: patient survived

Conditional prob:



(Q) probability of survival given that a patient was admin: M1

Conditioned on

$\rightarrow P(S|M_1)$ ← Notation

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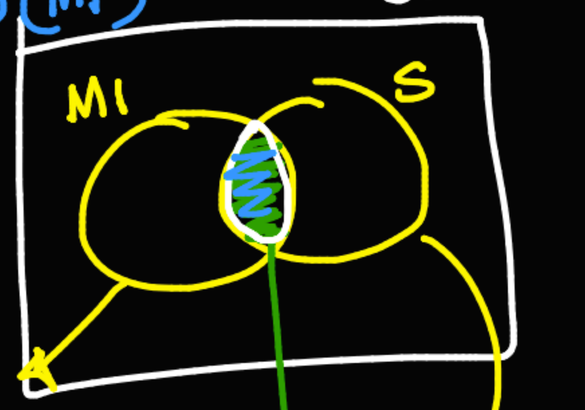
NOT $\frac{5}{100}$

$p(S|M_1) = \frac{95}{100}$

$\frac{p(M_1 \cap S)}{p(M_1)}$



U = 1000

{ 95 out of 100 patients who have been admin.. M1 survived

Visually

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00:34:41

12 / 12

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Chat

Notify me about: Nothing

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Srinivas MV To: Me 9:29 pm
0.05

Tai Rakesh To: Me 9:31 pm
95/100 as 95 people are survived out of 100

mohan To: Me 9:31 pm
0.95

SAVARA KALYAN To: Everyone 9:31 pm
.95

Srujana Kata To: Me 9:31 pm
0.95

Srinivas MV To: Me 9:31 pm
5 out of 100 survived with M1 so 5 %

Srujana Kata To: Me 9:31 pm
p(sand m1)/p(m1)=95/100=0.95

Adyashree Mahapatra To: Me 9:32 pm
95 out of 100 patients given medicine are survived.

9:33 pm
3

Srinivas MV To: Me 9:33 pm
got it

Yes No

To: Everyone Enable/Disable Chat

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$$\checkmark \left\{ \quad P(S|M_1) = \frac{P(S \cap M_1)}{P(M_1)} \quad \text{if } P(M_1) \neq 0 \right.$$

Someone has to take the medicine 1

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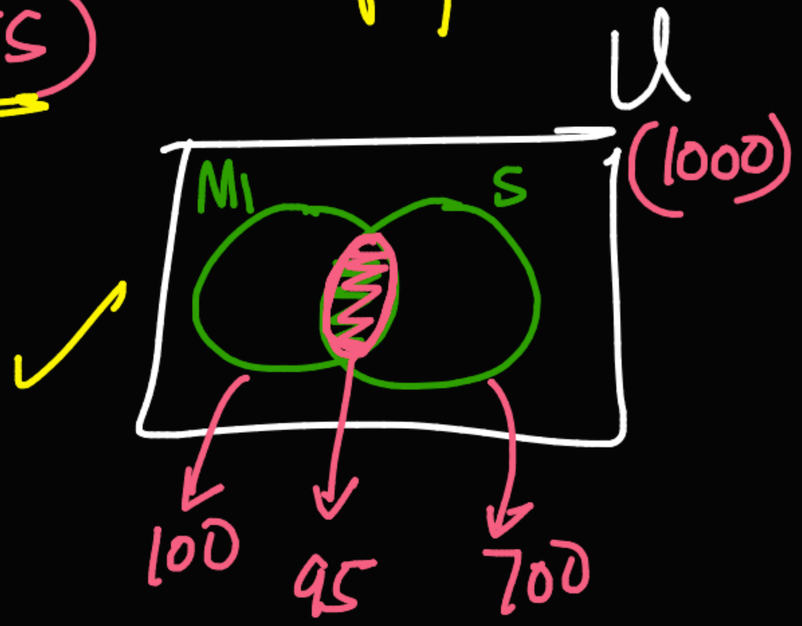
$$P(M_1|S) = \frac{95}{700} = \frac{P(M_1 \cap S)}{P(S)} \quad \text{if } P(S) \neq 0$$



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Srujana Kata To: Me 9:31 pm
p(sand m1)/p(m1)=95/100=0.95

Adyashree Mahapatra To: Me 9:32 pm
95 out of 100 patients given medicine are survived.

9:33 pm
3

Srinivas MV To: Me 9:33 pm
got it

Tai Rakesh To: Me 9:35 pm
that means someone has take medicine

Shashank Upadhyay To: Me 9:36 pm
so p(M1/S)
will be
p(M1 S)/P(S)

Tai Rakesh To: Me 9:36 pm
from the example, that means someone has to take medicine

Tai Rakesh To: Me 9:36 pm
yes

keshav kumar To: Me 9:37 pm
95/700

Yes 1 | No

To: Everyone | Enable/Disable Chat

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(Q) Two distinct dice. D1 ; D2

(Q) prob that sum of two dice equals 7 = E

given that D1 has shown value 3 = F

[define events properly] P(E|F)

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E: sum of 2 dice is 7

F: D1 results in 3

$P(E|F) = 1/6$

(intuitive) ✓

D1 D2

3 □

1 → 4
2 → 5
3 → 6
4 → 7 ✓
5 → 8
6 → 9

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16 / 18

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Formula

$$P(E|F) = \frac{P(E \cap F)}{P(F)} = \frac{1/36}{1/6} = \frac{1}{6}$$

SUM=7 and D1=3

D2=4

$$\{(1,1), (1,2), (1,3) \ldots$$

$$(2,1), (2,2) \ldots$$

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17 / 18

Srikanth Varma Chekuri (You)

People 25

Chat

Questions

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Chat

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to make sum is 1/6.

keshav kumar To: Me 9:41 pm

dice 1 has 3 already. that makes sample space as all variants on dice 2. and outcome is just 4 on dice 2

Srujana Kata To: Me 9:41 pm

only combination for 3 to get 7 is 4 , options on dice 2 is 6 so 1/6

Saurav Kumar To: Me 9:41 pm

because the first dice is fixed, so the second dice probability is 1/6

Shashank Upadhyay To: Me 9:41 pm

prob of getting 3 on frst dice is 1/6
and sum should be 7 so dice 2 should have 4
for
ans= (1/6)(1/6)

Rahul Singh To: Me 9:42 pm

as in event1 = 1/6 as {3} out of {1..6} , event2 = {4} out of {1..6}

9:43 pm

5

Srinivas MV To: Me 9:43 pm

if D1 is always 3, it is 1/6

Yes No

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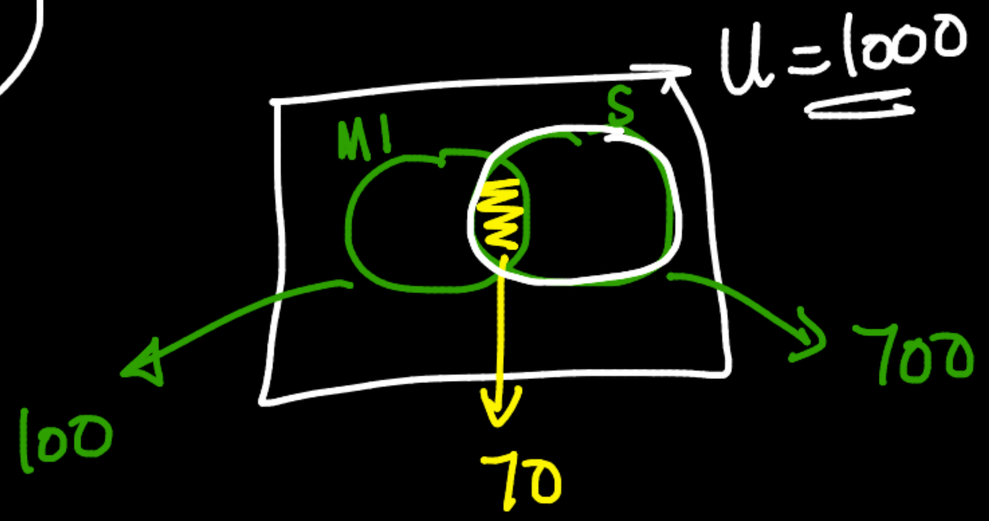
[same covid example] pfizer

{ Independent Events

M1

S

$P(S|M_1) = \frac{70}{100} = 0.7$



$P(S) = \frac{700}{1000} = 0.7$

→ survival prob with M_1 & without M_1 is the same

$$P(S|M_1) = 0.7 = P(S)$$

$\Downarrow$

{ patient survival (S) did not depend on M_1

$\Downarrow$

M_1 & S are independent events

Common-Confusion

Independent events

$M_1 \cap S \neq \phi$ (empty set)

neednot

$P(M_1 \cap S) \neq 0$

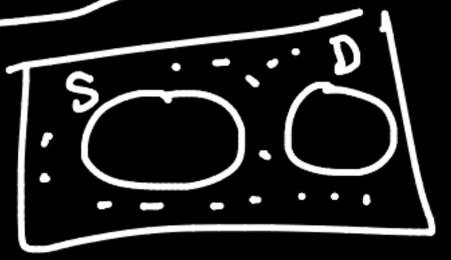
$P(S|M_1) = P(S)$

Mutually exclusive events

e.g: S : Survived
D : dead

$S \cap D = \phi$

$P(S \cap D) = 0$



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$P(S|M_1) = P(S)$

M1 doesnot Impact the survival of the patient

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00:56:31

21 / 21

Srikanth Varma Chekuri (You)

People 25

Chat

Questions

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Rahul Singh To: Me 9:48 pm
.7

Shashank Upadhyay To: Me 9:48 pm
.7

Srinivas MV To: Me 9:48 pm
700/1000

Harini To: Me 9:49 pm
700/1000

Saurav Kumar To: Me 9:49 pm
700/1000

keshav kumar To: Everyone 9:51 pm
can we say, medicine does not cause survival or will that be a wrong statement? in strictest sense.

Harini To: Me 9:54 pm
So all MEE are independent events but not all independent events are MEE?

9:55 pm
4

9:56 pm
1

Yes No

To: Everyone Enable/Disable Chat

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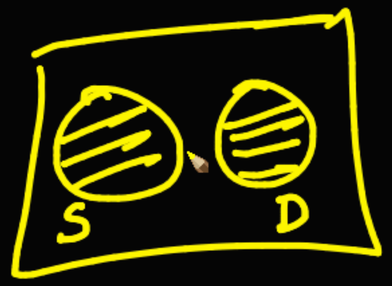
GEOMRTT

✓ { Mut. excl. events

✓ { S, D
$S \cap D = \phi$



indep ⟹ $P(A|B) = P(A)$

$P(S|D) \neq P(S)$

$\Leftarrow$ if $P(S) = 0$

$\frac{P(S \cap D)}{P(D)} = 0$

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01:04:48

22 / 24

Srikanth Varma Chekuri (You)

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Chat

Notify me about: Nothing

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need not be but can be ?

9:59 pm 1

keshav kumar To: Everyone 10:02 pm
ok

Safwan To: Everyone 10:02 pm
in this case isnt it there has to be 2 dice or 2 throw

Safwan To: Everyone 10:02 pm
?

10:02 pm 1

Safwan To: Everyone 10:02 pm
but given B means

Safwan To: Everyone 10:02 pm
already already happened?

Shashank Upadhyay To: Me 10:03 pm
i got confused between MEE and independent event
can you please explain again if possible

10:04 pm 1

Yes No

To: Everyone Enable/Disable Chat

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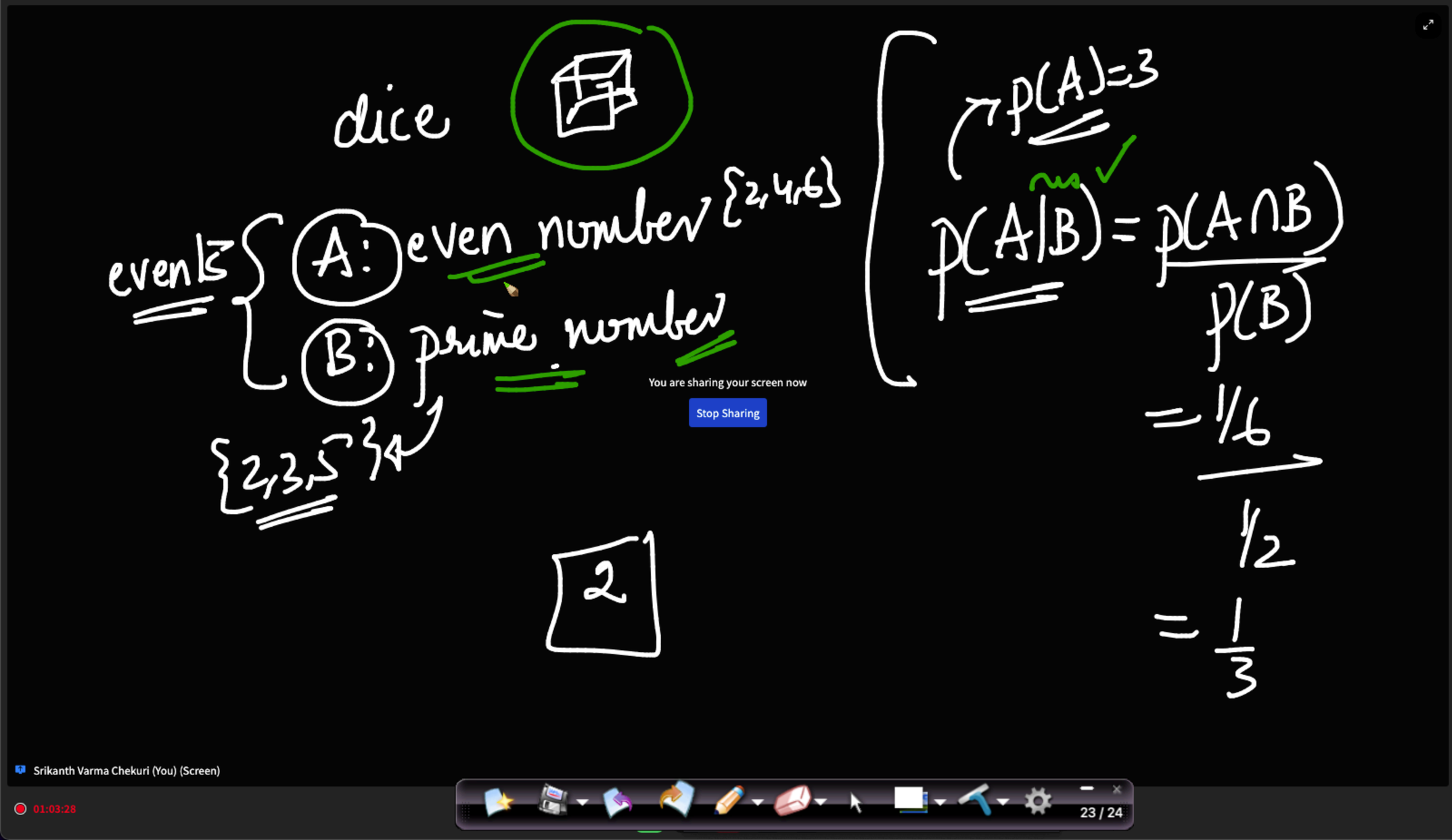

Srikanth Varma Chekuri (You) (Screen)

01:03:28

23 / 24

People 25

Chat

Questions

Chat

Notify me about Nothing

Pin a message

Aayushi Jain To: Me 9:59 pm
need not be but can be ?
9:59 pm 1

keshav kumar To: Everyone 10:02 pm
ok

Safwan To: Everyone 10:02 pm
in this case isnt it there has to be 2 dice or 2 throw

Safwan To: Everyone 10:02 pm
?
10:02 pm 1

Safwan To: Everyone 10:02 pm
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Safwan To: Everyone 10:02 pm
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Shashank Upadhyay To: Me 10:03 pm
i got confused between MEE and independent event
can you please explain again if possible

Yes No

To: Everyone Enable/Disable Chat

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$$P(SUDUC) = P(U) = \frac{1000}{1000} = 1$$

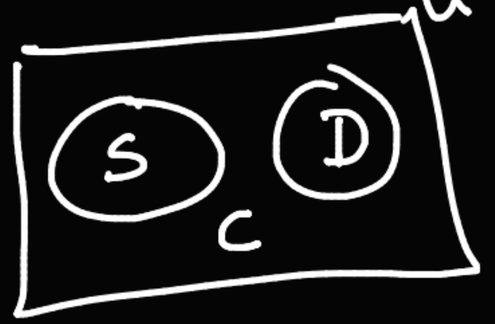
Mutually exclusive and exhaustive events

✓ S : survived

D : dead

C : medical cases currently

$U = 1000$



$SUDUC = U$

$S \cap D = \phi$

$S \cap C = \phi$

$D \cap C = \phi$

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01:11:19

24 / 25

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1

Saurav Kumar To: Me 10:09 pm
0

Praveen Galagali To: Everyone 10:09 pm
1?

Aayushi Jain To: Me 10:09 pm
1

Tai Rakesh To: Me 10:09 pm
p(s)+d+c

Saurav Kumar To: Me 10:09 pm
1

Saurav Kumar To: Me 10:09 pm
typo

Tai Rakesh To: Me 10:09 pm
1 total max probability

Praveen Galagali To: Everyone 10:10 pm
one of the event will occur for sure

Deepak Mittal To: Me 10:10 pm
event D intersection event C should be phi in the previous page

Yes No

To: Everyone Enable/Disable Chat

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People Chat Questions Start Doubt Session

personal

$$\{ P(A|\tilde{B}) = P(A) \longrightarrow \text{independence}$$

derived

$$P(A \cap B) = P(A|B)\,P(B) \quad [\because P(A|B) = \frac{P(A \cap B)}{P(B)}]$$

$$\checkmark\ P(A \cap B) = P(A)\,P(B) \longrightarrow \text{independence}$$

2 2 2 2 ... 2

Q

n coins that are tossed

E_i : event that i^{th} coin is a head $= 1/2$

Prob of all n-coins turning heads ? $= \frac{1}{2^n}$

1. one case out of $2^n = 1/2^n$

→ 2. $P(E_1 \cap E_2 \cap E_3 \cap \dots \cap E_n) = P(E_1)\,P(E_2) \cdots P(E_n)$ (1/2 1/2 1/2)

$= \frac{1}{2^n}$

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(Q) Given: M_1 and S are independent events = 70%. $P(S|M_1) = P(S)$

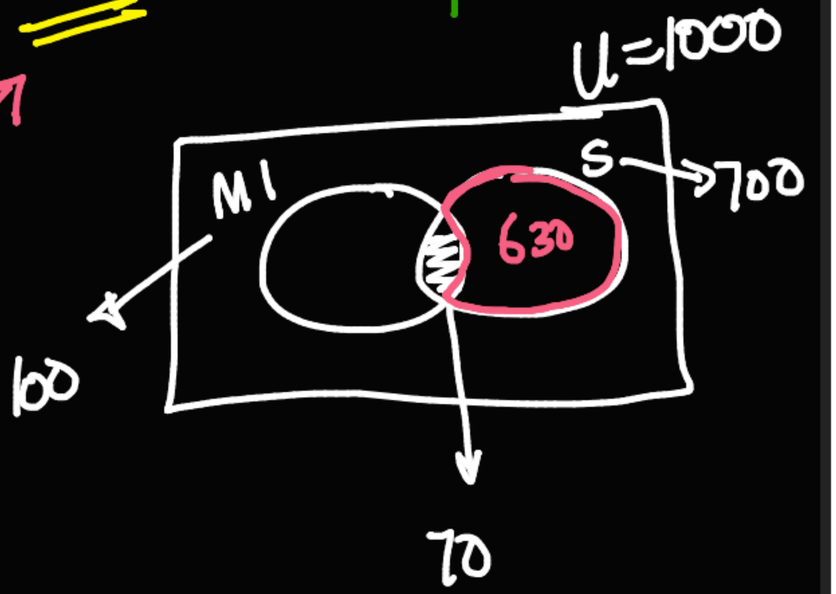
Can we say: M_1^c and S are also independent ?

NOT M_1

$M_1' \text{ or } M_1^c$

if $P(S|M_1^c) = P(S)$

$\frac{630}{900} = 0.7 = \frac{700}{1000}$



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27 / 27

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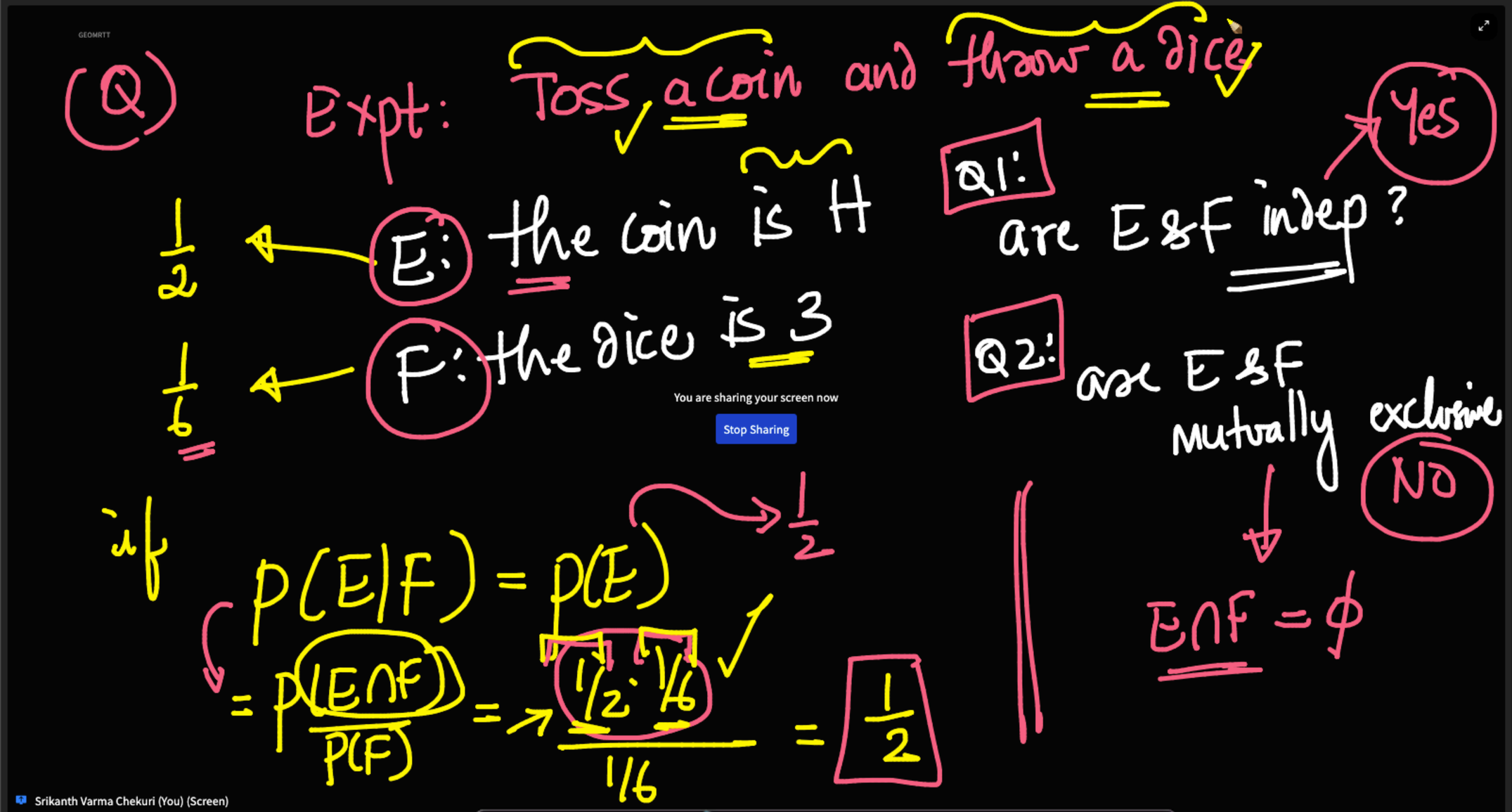

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$P(E \cap F) =$

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GEOMRTT
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01:31:18

29 / 29

Srikanth Varma Chekuri (You)

People 24

Chat

Questions

Chat

Notify me about Nothing

event e does not impact occurence of event

Pin a message

Safwan To: Everyone 10:27 pm
Q2 no mutually exlusive

Srinivas MV To: Me 10:27 pm
Q1:yes : Q2: no

Tim Sabu To: Me 10:27 pm
not mutually exclusive

mohan To: Me 10:27 pm
yes, no

Adyashree Mahapatra To: Me 10:28 pm
P(H and 3)/P(3) = 0 which is not equal to P(H)= 1/2

Saurav Kumar To: Me 10:28 pm
1/2*1/6 =1/12

Prabhakar Patra To: Me 10:29 pm
1/12

Adyashree Mahapatra To: Me 10:31 pm
but we can take P(E and F) = P(E) *P(F) only when we assume that they are independent. So, how we take this value to prove independence?

10:31 pm
5

Yes No

To: Everyone Enable/Disable Chat

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1,2,3,4,5,6

E1: dice shows even num

E2: dice shows odd num

↳ mutually exclusive

$E_1 \cap E_2 = \phi$

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30 / 30

Srikanth Varma Chekuri (You)

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Questions

Chat

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P(H and 3)/P(3) = 0 which is not equal to P(H)= 1/2

Saurav Kumar To: Me 10:28 pm

1/2*1/6 =1/12

Prabhakar Patra To: Me 10:29 pm

1/12

Adyashree Mahapatra To: Me 10:31 pm

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10:31 pm

5

Shashank Upadhyay To: Me 10:32 pm

if
E1: dice show even number
E2: dice show odd number
so can we say
then E1 and E2 are MEE

10:33 pm

1

Tai Rakesh To: Everyone 10:33 pm

are all mutual exclusive events are indeopendent

Yes No

To: Everyone Enable/Disable Chat

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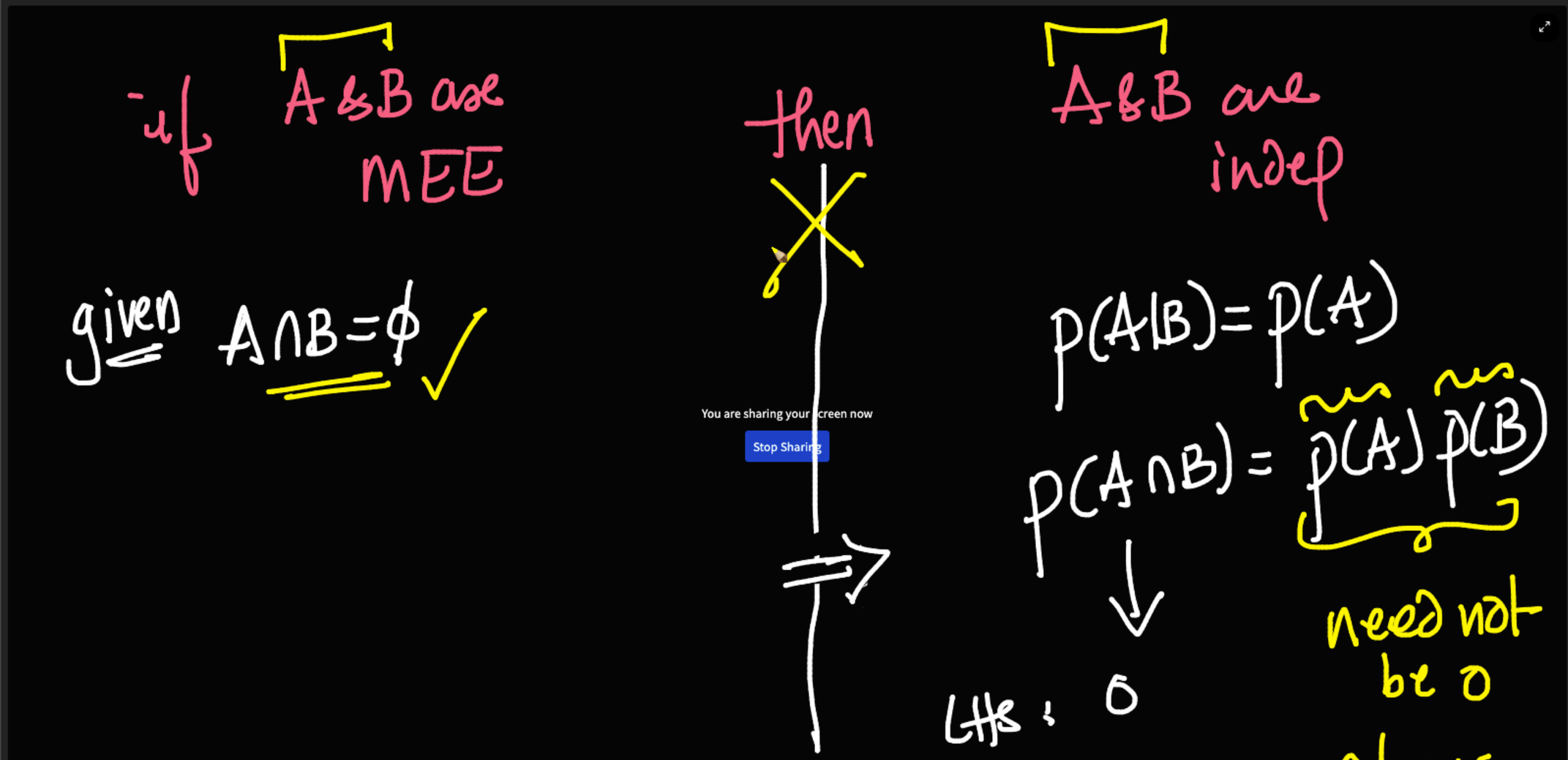

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31 / 31

Srikanth Varma Chekuri (You)

People 24 | Chat | Questions

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Saurav Kumar To: Me 10:28 pm
1/2*1/6 =1/12

Prabhakar Patra To: Me 10:29 pm
1/12

Adyashree Mahapatra To: Me 10:31 pm
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10:31 pm
5

Shashank Upadhyay To: Me 10:32 pm
if
E1: dice show even number
E2: dice show odd number
so can we say
then E1 and E2 are MEE

10:33 pm
1

Tai Rakesh To: Everyone 10:33 pm
are all mutual exclusive events are indeopendent

Shashank Upadhyay To: Me 10:34 pm
yes

Yes No

To: Everyone Enable/Disable Chat

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Start Doubt Session

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DSML Advanced : Probability & Statistics Remedial -1 | Lecture

(Q) A and B are two events ; which of the following are always true

MSQ

(a) $P(A \cap B) = P(A)\,P(B)$ → iff A & B indep

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

(b) $P(A \cup B) = P(A) + P(B)$ → MEG

$A \cap B = \phi$

0 ... 1

(c) $P(A|B) = P(A \cap B)\,P(B)$ X

(d) $P(A \cup B) \leq P(A) + P(B)$

$A \cup B = A + B - A \cap B$

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01:44:31

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Srikanth Varma Chekuri (You)

People 23 | Chat | Questions

Chat

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SAVARA KALYAN To: Me 10:39 pm
d

Tai Rakesh To: Everyone 10:40 pm
d

Harini To: Me 10:40 pm
only d since we don't know anything else about a and b

Saurav Kumar To: Me 10:40 pm
d

Srujana Kata To: Me 10:40 pm
none

keshav kumar To: Me 10:41 pm
d alone

Shashank Upadhyay To: Me 10:41 pm
d

Srujana Kata To: Me 10:44 pm
how can union less than Aunion B

10:44 pm
4

Srujana Kata To: Me 10:44 pm
typo

Yes No

To: Everyone Enable/Disable Chat

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DSML Advanced : Probability & Statistics Remedial -1 | Lecture

$P(A \cup B) \leq P(A) + P(B) - P(A \cap B)$

.9 .6 .35 0.05

0 to 1

if 0 → $P(A \cup B) = P(A) + P(B)$

if +0 $P(A \cup B) < P(A) + P(B)$

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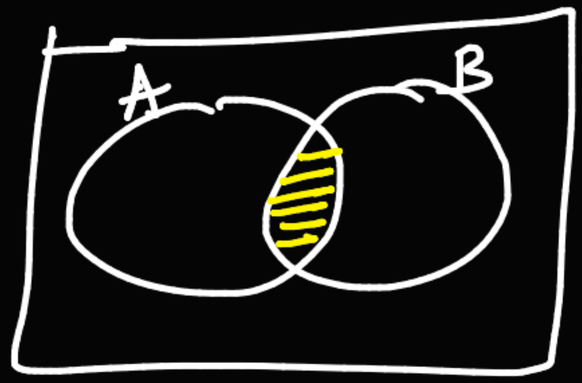
DSML Advanced : Probability & Statistics Remedial -1 | Lecture

GEOMRTT

$A \cup B = A + B - A \cap B$



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01:46:57

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Srikanth Varma Chekuri (You)

People 23

Chat

Questions

Chat

Notify me about Nothing

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Tai Rakesh To: Everyone 10:40 pm
d

Harini To: Me 10:40 pm
only d since we don't know anything else about a and b

Saurav Kumar To: Me 10:40 pm
d

Srujana Kata To: Me 10:40 pm
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d

Srujana Kata To: Me 10:44 pm
how can union less than Aunion B

10:44 pm
4

Srujana Kata To: Me 10:44 pm
typo

Srujana Kata To: Me 10:44 pm
how can union less tha a +B

Yes No

To: Everyone Enable/Disable Chat

Type message

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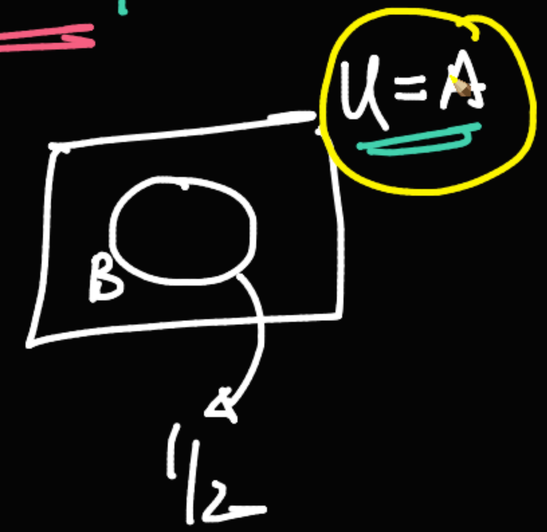
(Q)

given $\Rightarrow U=A$

$P(A)=1$; $P(B)=1/2$

$P(A|B)$ & $P(B|A)$



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a) 1

b) $P(B)=\frac{1}{2}$

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01:51:35

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Srikanth Varma Chekuri (You)

People 23

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Questions

Chat

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Tai Rakesh To: Me 10:48 pm
p(b/a)=1/2**

Srujana Kata To: Me 10:49 pm
not possible until u mention relation between A and B

Safwan To: Everyone 10:49 pm
a = 1 and b = 1/2 as its independent events

Tai Rakesh To: Me 10:50 pm
p(A/B)=1 A occurs compulsory irrespective of B
p(B/a)=1/2 A occurs compulsory all the tinme

keshav kumar To: Me 10:50 pm
a=1, b = 1/2 . in case a, b has already occurred and event a will always occur hence a is 1.

Harini To: Me 10:50 pm
since p(A) = 1 it means it's a sure event. So P(A/B) is also 1 and p(B/A) = 1/2

keshav kumar To: Me 10:51 pm
in case of b, event a has already occurred and its sure event hence occurence of event B is independent of event A

Yes No

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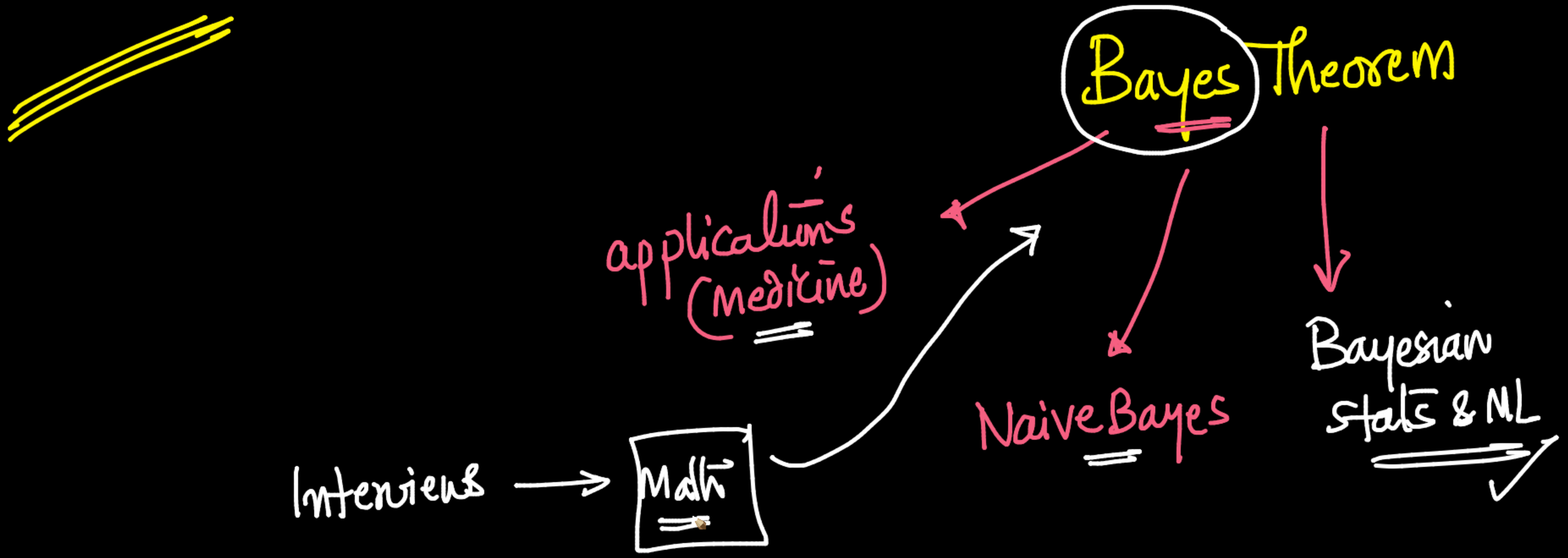


Bayes Thm

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)} \quad \text{if } P(B) \neq 0$$

cond. prob

proof:

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B \cap A)}{P(B)} = \frac{P(B|A)\,P(A)}{P(B)}$$

if $P(B) \neq 0$

Real-world

XYZ

Rapid RT-PCR

5 min, Rs 100

1. accurately returns +ve if the patient has covid } = 90%

2. returns +ve if patient doesnot have covid } = 10%

Let's assume 1% of the population has covid

Rapid RT PCR → returns +ve

What is the prob that  actually has covid?

have covid

rapid RTPCR +ve

$P(C \mid +ve) = ?$

Bayes Thm

$$P(C \mid +ve) = \frac{P(+ve \mid C)\, P(C)}{P(+ve)}$$

$P(+ve \mid C) = 0.9$

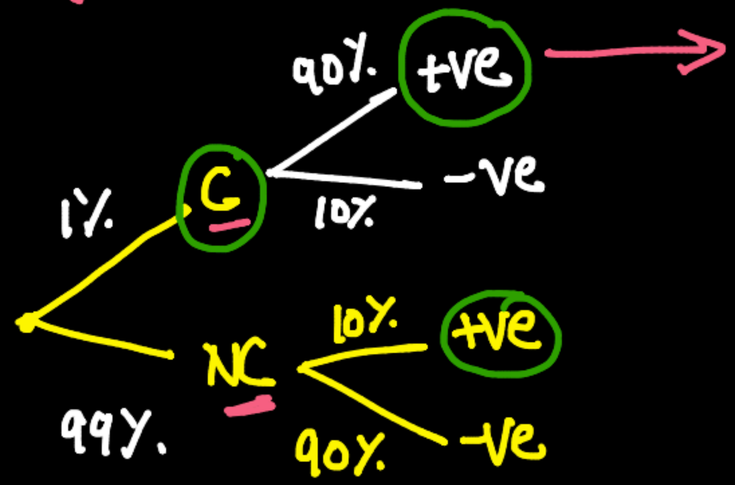
$P(C) = 0.01$

$P(+ve) \rightarrow ? = 0.108$

$$= \frac{9}{108} = 8.3\%$$

Counter intuitive

$\widetilde{P(+ve)} = ?$



$$P(\widetilde{+ve}) = P(\widetilde{+ve} \cap C) + P(\widetilde{+ve} \cap NC)$$

$$= P(+ve|C)\,P(C) + P(+ve|NC)\,P(NC)$$

$$= 0.9 \times 0.01 + 0.1 \times 0.99 = 0.108$$

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   Scanner should be present in the top menu on your iPad
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   All notes uploaded will be visible in the saved version of this session

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Drag and drop files or **click here to upload**

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