13th Feb. 2023

Probability & Statistics

Class #1

Welcome to Maths Module !

let's start @ 9:05

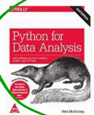
Industrial Example of Probability.

yellow

Orange

$ Revenue

Frequently bought together



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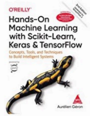

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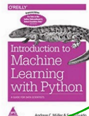

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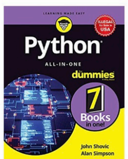

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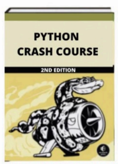

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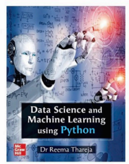

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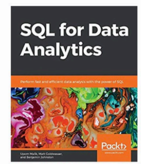

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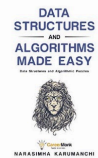

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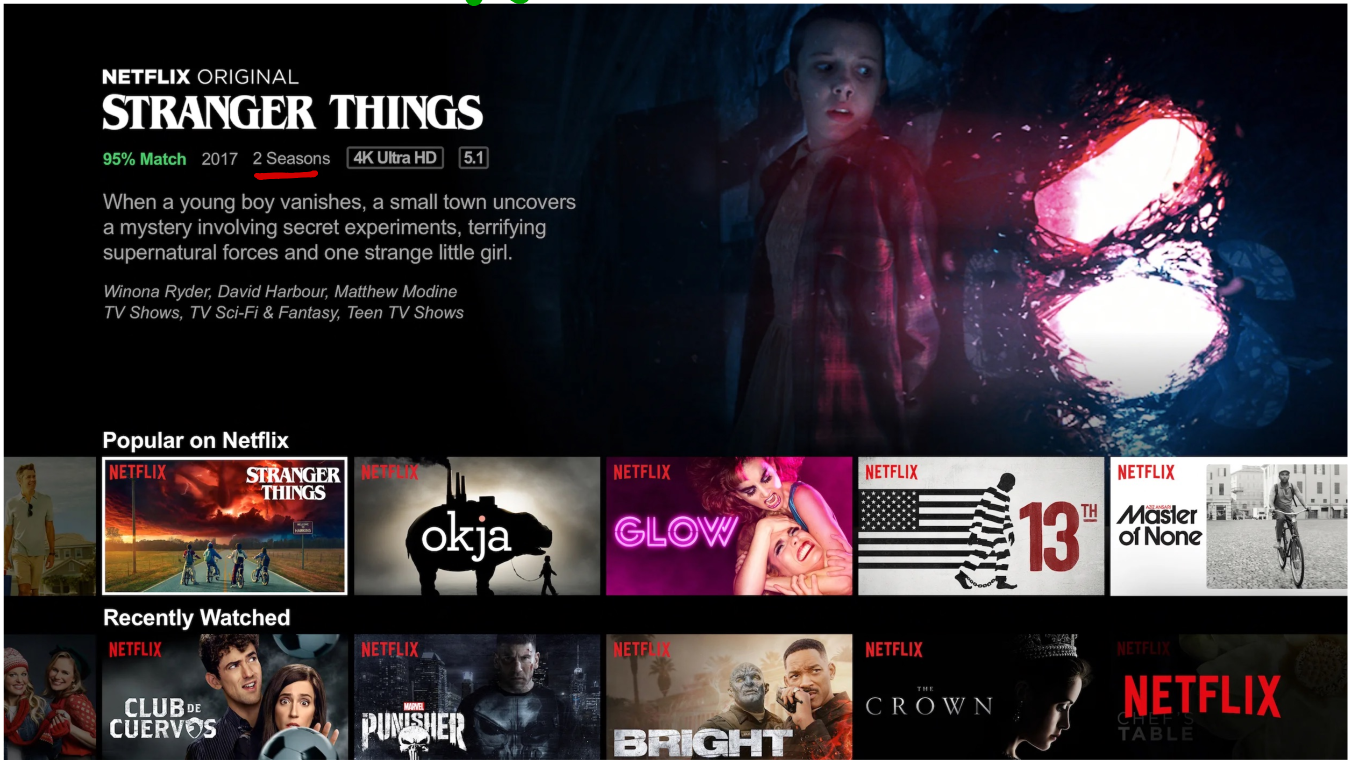

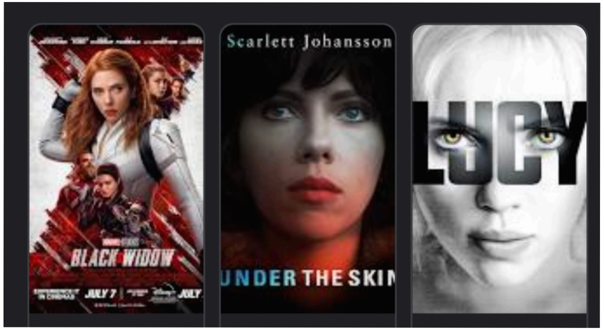

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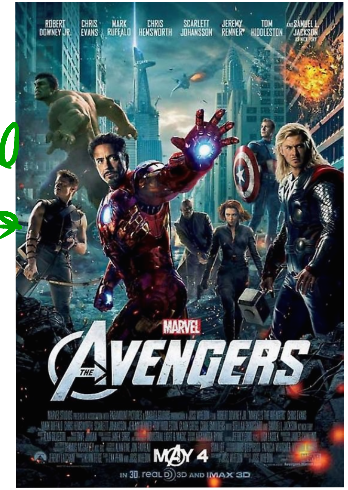


Scarlet is Shivam's favourite.

(Shown to me)

Financial domain - Probability

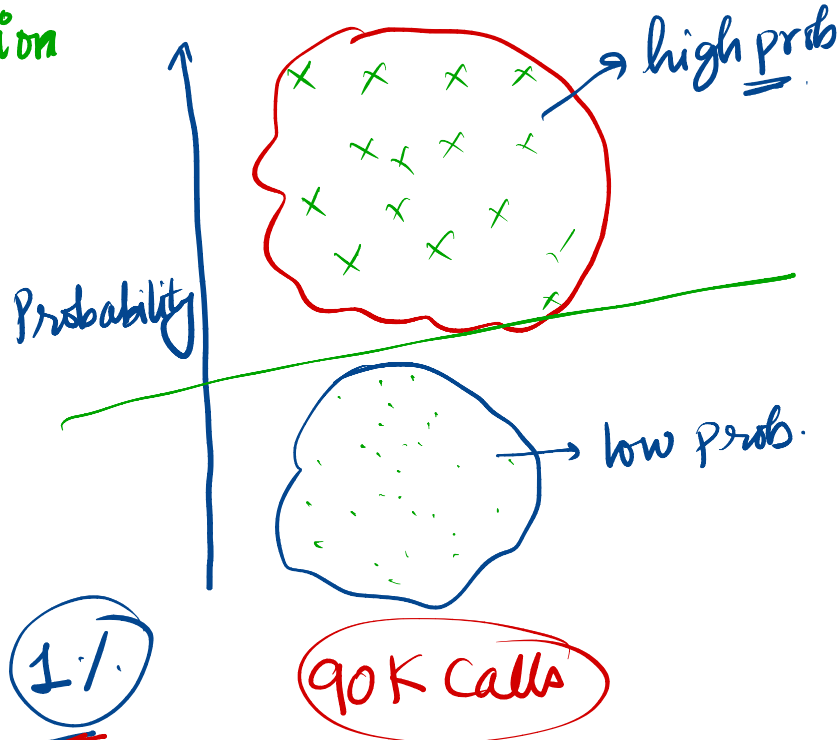
Bank → 10 million

1000 Calls

100 responded

↘ ~0.01%

10K calls → 100 → 1%



Basic Terminologies :

Experiment → ?

$$2H_2 + O_2 \longrightarrow 2H_2O$$

water.

100%

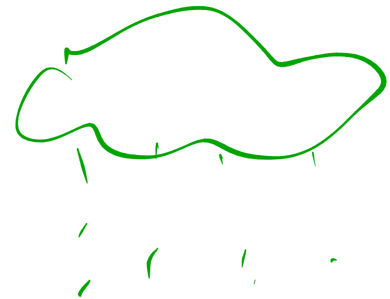
Prob. = 1.0

deterministic Expt.

$$1 + 2 = 3$$

Random Experiments : (outcome is unknown).

- Coin toss (H / T)
- Die (1 to 2)
- Rain (Y / N)
- Child Birth (B / G)
- Rainfall (in mm)



Experiments - Random :

×

Outcome :

Toss a coin : {H} {T}

die : {1}, {2}, {3}, {4}, {5}, {6}

SampleSpace : → {collection of all possible outcomes)

Coin : {H, T}

die : {1, 2, 3, 4, 5, 6}

Event : SS of die = {1, 2, 3, 4, 5, 6}

E_1 : getting all odd #'s = {1, 3, 5}

E_2 : ——— even #'s = {2, 4, 6}

E_3 : getting perfect square = {1, 4}

Event is Subset of Sample Space.

E_4 : {1, 4, 7} not an event → Impossible event.

7 → not a part of SS.

Sample Spaces

Akash $\rightarrow$ A

Vaibhav $\rightarrow$ V

A $\rightarrow$ Die or D_1

V $\rightarrow$ D_2

D_1 \ D_2	1	2	3	4	5	6
1	(1,1)	(1,2)				(1,6)
2		(2,2)				
3			(3,3)			
4						
5						
6	(6,1)					(6,6)

Sample Space

$= 6 \times 6$

$= 36$ elements in SS

$A \to C_1 \qquad V \to C_2$.

Tossing two coins

C_1	C_2
H	H
H	T
T	H
T	T

Sample space = { HH, HT, TH, TT }.

$\Rightarrow$ 4 elements

Event:

E_1 = At least 1 head = {HH, HT, TH}

E_2 = Both same = {HH, TT}

Mix Match

A → Coin   V → Die

$\underbrace{H \qquad T}_{2} \times \underbrace{1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6}_{6} = 12.$

$$SS = \left\{ \begin{matrix} (H,1) & (H,2) & (H,3) & (H,4) & (H,5) & (H,6) \\ (T,1) & (T,2) & (T,3) & (T,4) & (T,5) & (T,6) \end{matrix} \right\}$$

Betting game : **Die** SS : $\{1,2,3,4,5,6\}$

A $\rightarrow \{1,3,5\} = E_1$ ✓

V $\rightarrow \{1,5,6\} = E_2$ ✓

(Akash and Vaibhav)

① **Winning Together** : (finding something common in E_1 & E_2)

$E_1 \cap E_2 = \{1,5\} \rightarrow$ Intersection of Events

② **Anyone Wins** (Akash or Vaibhav)

$\{1,3,5,6\} = E_1 \cup E_2 \rightarrow$ Union of Events

Set Operations *

* $A \rightarrow \{1, 3, 5\} = E_1$ $\quad V \rightarrow \{2, 4, 6\} = E_2$

$\Rightarrow E_1 \cap E_2 =$ null $= \{ \}$ "ϕ"

[Mutually Exclusive Events]

(Disjoint Sets)

$A \rightarrow \{1, 2\} = E_1$ $\quad$ $V \rightarrow \{3, 4, 5, 6\} = E_2$

$SS = \{1, 2, 3, 4, 5, 6\}$

$E_1 + E_2 = SS$

E_2 is compliment of E_1 & vice versa.

$$\left.\begin{array}{l} \boxed{E_2 = E_1^c} \\ \boxed{E_1 = E_2^c} \end{array}\right\} \text{Compliment}$$

$$\left.\begin{array}{l} A \longrightarrow \{1\} \\ V \longrightarrow \{5\} \end{array}\right\} \text{mutually Exclusive}$$

$$A + V \longrightarrow 55$$

Probability

Coin

$SS = \{H, T\} \rightarrow$ 2 elements.

$E_1 \rightarrow$ getting a head $\rightarrow E_1 = \{H\} \rightarrow$ 1 element.

$$P(E_1) = \frac{\text{\# of elements in event space}}{\text{Total \# of elements in Sample space}} = \frac{1}{2}$$

$$P(E_1) = 1/2 = 0.5 = 50\%.$$

Die : $SS = \{1, 2, 3, 4, 5, 6\}$

E_1 = odd #'s = $\{1, 3, 5\}$ $\Rightarrow P(E_1) = \frac{3}{6} = \frac{1}{2}$

E_2 = even #'s $= \{2, 4, 6\}$ $\Rightarrow P(E_2) = \frac{3}{6} = \frac{1}{2}$

E_3 = Perfect sq. $= \{\underline{1, 4}\}$ $\Rightarrow P(E_3) = \frac{2}{6} = \frac{1}{3}$

Die : $SS = \{1, 2, 3, 4, 5, 6\}$

Akash

$E_1 = \{1, 2, 3\}$

$P(E_1) = \frac{1}{2}$

Vaibhav

$E_2 = \{1, 4, 5\}$

$P(E_2) = \frac{1}{2}$

$\Rightarrow (E_1 \cap E_2) = \{1\} \Rightarrow P(E_1 \cap E_2) = 1/6$

$\Rightarrow (E_1 \cup E_2) = \{1, 2, 3, 4, 5\} \Rightarrow P(E_1 \cup E_2) = 5/6$

Can I say $\underbrace{P(E_1 \cup E_2)}_{5/6} = \underbrace{P(E_1)}_{1/2} + \underbrace{P(E_2)}_{1/2} \rightarrow ?$

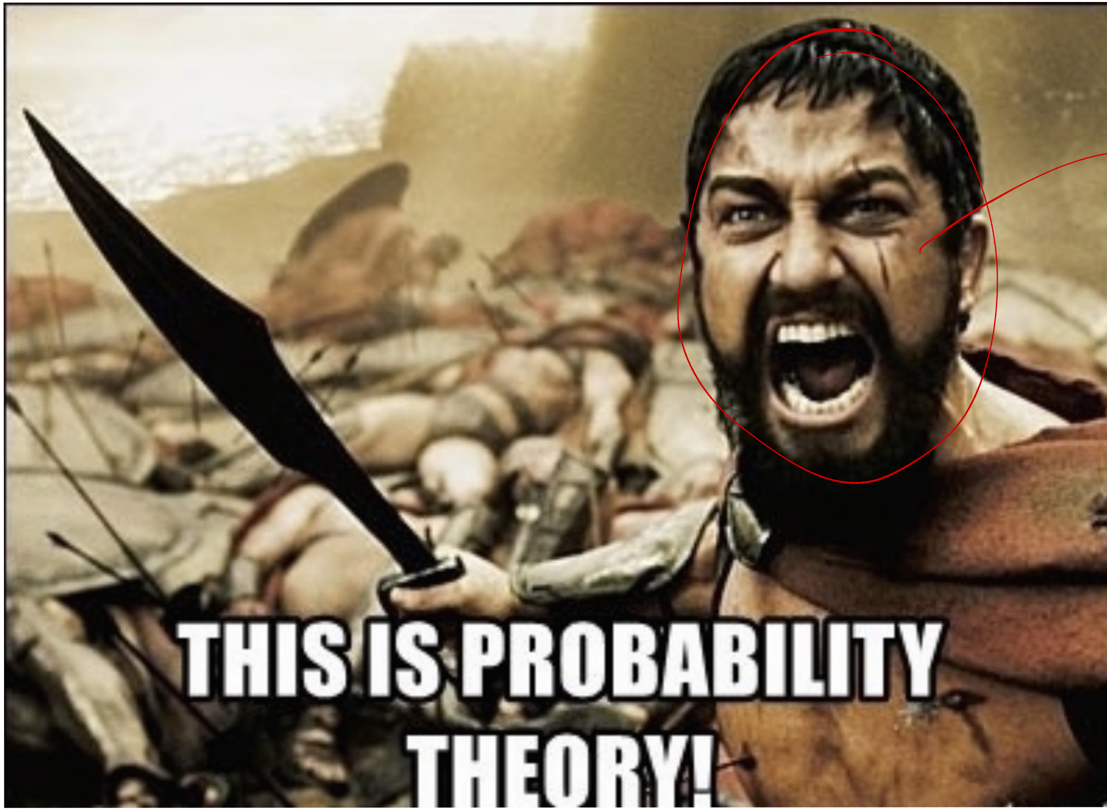
$$\frac{5}{6} \neq 1$$

$$P(E_1) + P(E_2) - P(\{1\})$$

$$\left(\frac{1}{2} + \frac{1}{2}\right) - \frac{1}{6} = 1 - \frac{1}{6} = \frac{5}{6}.$$

$$\boxed{P(E_1 \cup E_2) = P(E_1) + P(E_2) - P(E_1 \cap E_2)}$$

Addition Rule of PROBABILITY



Leonidas

300 movie *

exhaustive