

(Section-2)

MA 20205

Probability and statistics

Slot (B3)

Mon - 11 to 12

Tue - 8 to 10

Swanand Khare

(Syllabus and text-book names  
etc will be uploaded after  
the class)

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## Probability:

Random Expt: An experiment whose outcome is uncertain.

Ex:

1) R: Tossing a coin  
 $\Omega = \{\text{Heads, Tails}\}$

$\{H\}$

2) R: Roll a die  
 $\Omega = \{1, 2, 3, 4, 5, 6\}$

$\{2, 4, 6\}$

3) R: Current observation in mA in an ammeter.  
 $\Omega = (10 - \epsilon, 20 + \epsilon)$  for some  $\epsilon > 0$ .

4)  $R$ ; Waiting time in a queue

$$\Omega = \mathbb{R}_+ = [0, \infty) \cup \{0\}$$

$[0, 3]$

$\left[ \begin{array}{l} \text{uncountable} \end{array} \right.$

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1) Random experiment.

2) Set of all possible outcomes : Sample space  $(\Omega/S)$

3) Events : subsets of  $\Omega$  which are of particular interest.

4) Assigning probability : (to the events of interest)  
(This assignment cannot be done arbitrarily.)

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The assignment is done with some rules/axioms (This will lead to axiomatic definition of probability).

Ex:

R: Toss a coin until first head appears.

H: Heads, T: Tails

$\{H, TH, TTH, TTTH, \dots\} = \Omega$  } Random variable

$\{1, 2, 3, 4, \dots\} = \mathbb{N}$

*(Note: Red arrows point from H to 1, TH to 2, TTH to 3, and TTTH to 4 in the original image.)*

$$E = \{H\}$$

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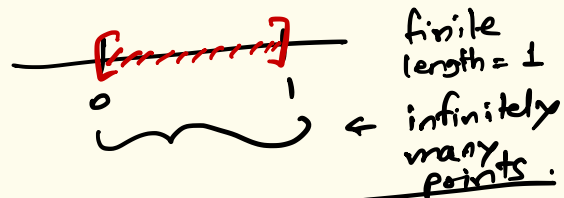
Probability Assignment:

Types of sample spaces, (finite, infinite)  
(countable, uncountable)

Ex:  
R: Picking a number randomly from  
a set  $\{1, 2, \dots, N\}$   $\omega$

$$\Omega = \{1, 2, \dots, N\}$$

Ex: R: Picking a number randomly from  
the set  $[0, 1]$



$$\Omega = [0, 1]$$

A set is countable if there is a bijection from  
the set to  $\mathbb{N}$ .  
(continuum)

$$\Omega = [0, 1]$$

We can not

in  $[0, 1]$

enlist all the real numbers

as  $x_1, x_2, x_3, \dots$

$$a_1, a_2 \in \{0, 1\}$$

$$0. \textcircled{a_1} a_2 a_3 a_4 \dots$$

$$0. b_1 \textcircled{b_2} b_3 b_4 \dots$$

$$0. c_1 c_2 \textcircled{c_3} c_4 \dots$$

0

$$0. \tilde{0} \tilde{0} \tilde{0} \tilde{0} \tilde{0} \tilde{0}$$

## Probability assignment:

1)  $R$ : Tossing a coin

$$\Omega = \{H, T\}$$

$$A = \{H\}$$

$$P(A) = \frac{1}{2} \quad (\text{unbiased coin})$$

Q: Assign probability to  $A = \{H\}$ .

We do Not know if the coin is biased or not.

Suggestion: Repeat R 'n' number of times.

$$f_A = \frac{\text{no. of Heads}}{n} \quad (\text{relative frequency})$$

As  $n \rightarrow \infty$ ,  $f_A \rightarrow \text{Probability } \{H\}$