Statistical and Mathematical Methods for Data Analysis

Dr. Syed Faisal Bukhari

Associate Professor

Department of Data Science

Faculty of Computing and Information Technology

University of the Punjab

Textbooks

- **Probability & Statistics for Engineers & Scientists**, Ninth Edition, Ronald E. Walpole, Raymond H. Myer

- **Elementary Statistics: Picturing the World,** 6th Edition, Ron Larson and Betsy Farber

- **Elementary Statistics,** 13th Edition, Mario F. Triola

Reference books

- **Probability Demystified**, Allan G. Bluman
- **Schaum's Outline of Probability and Statistics**
- **MATLAB Primer**, Seventh Edition
- **MATLAB Demystified** by McMahon, David

References

Readings for these lecture notes:

- **Schaum's Outline of Probability, Second Edition (Schaum's Outlines)**

  by by Seymour Lipschutz, Marc Lipson

- **Probability & Statistics for Engineers & Scientists**, Ninth Edition, Ronald E. Walpole, Raymond H. Myer

These notes contain material from the above resources.

Finite Stochastic Processes And Tree Diagrams

- A (finite) sequence of experiments in which each experiment has a finite number of outcomes with given probabilities is called a **(finite) stochastic process.**

- A convenient way of describing such a process and computing the probability of any event is by a **tree diagram.**

Example:

We are given three boxes as follows:

Box 1 has **10** light bulbs of which **4** axe defective.

Box 2 has **6** light bulbs of which **1** is defective.

Box 3 has **8** light bulbs of which **3** are defective.

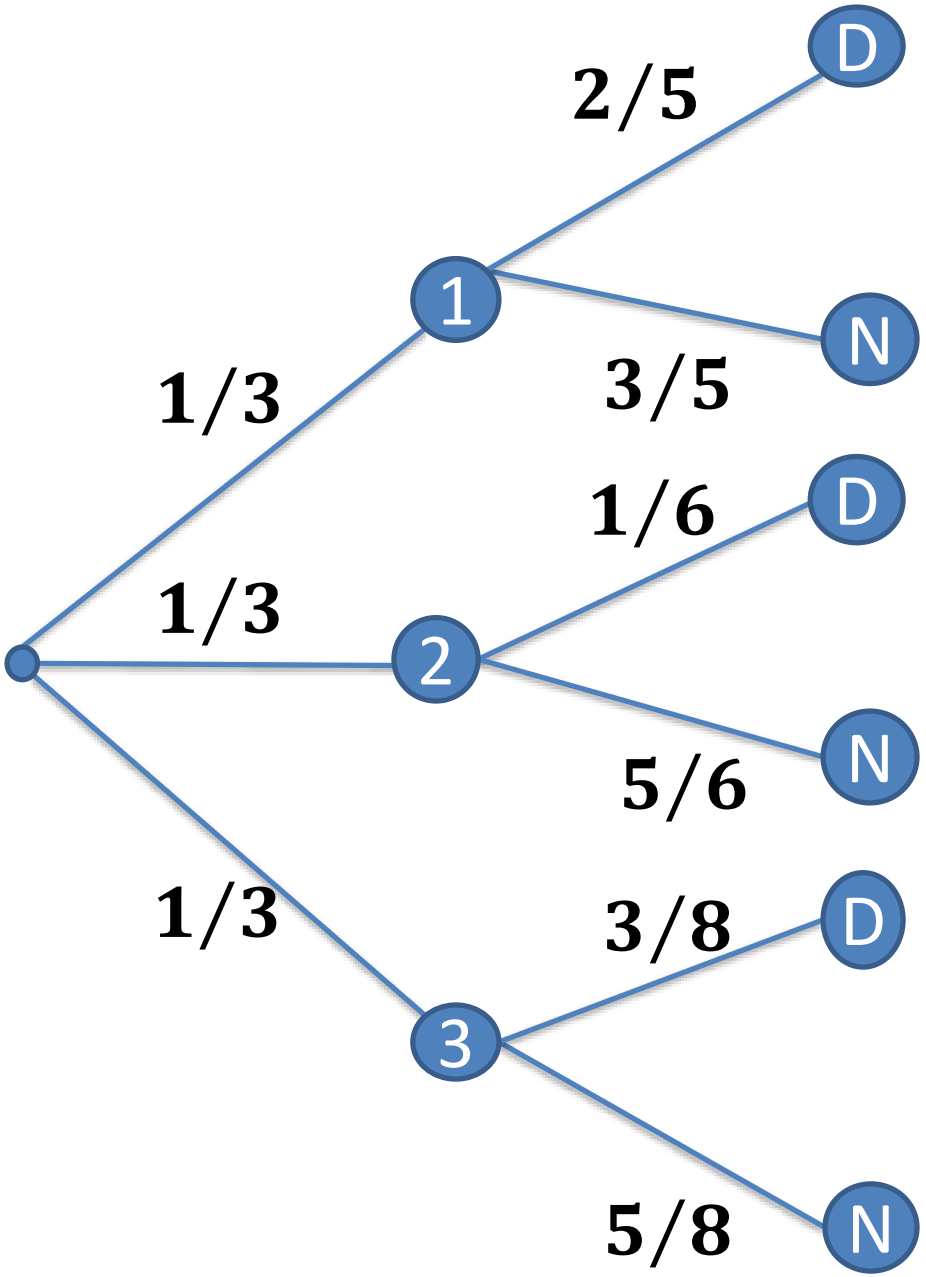
We select a box at random and then draw a bulb at random. What is the probability **p** that the **bulb** is **defective**?

Solution:

Here we perform a sequence of two experiments:

(i) select one of the three boxes;

(ii) select a bulb which is either defective ***(D)*** or nondefective ***(N).***

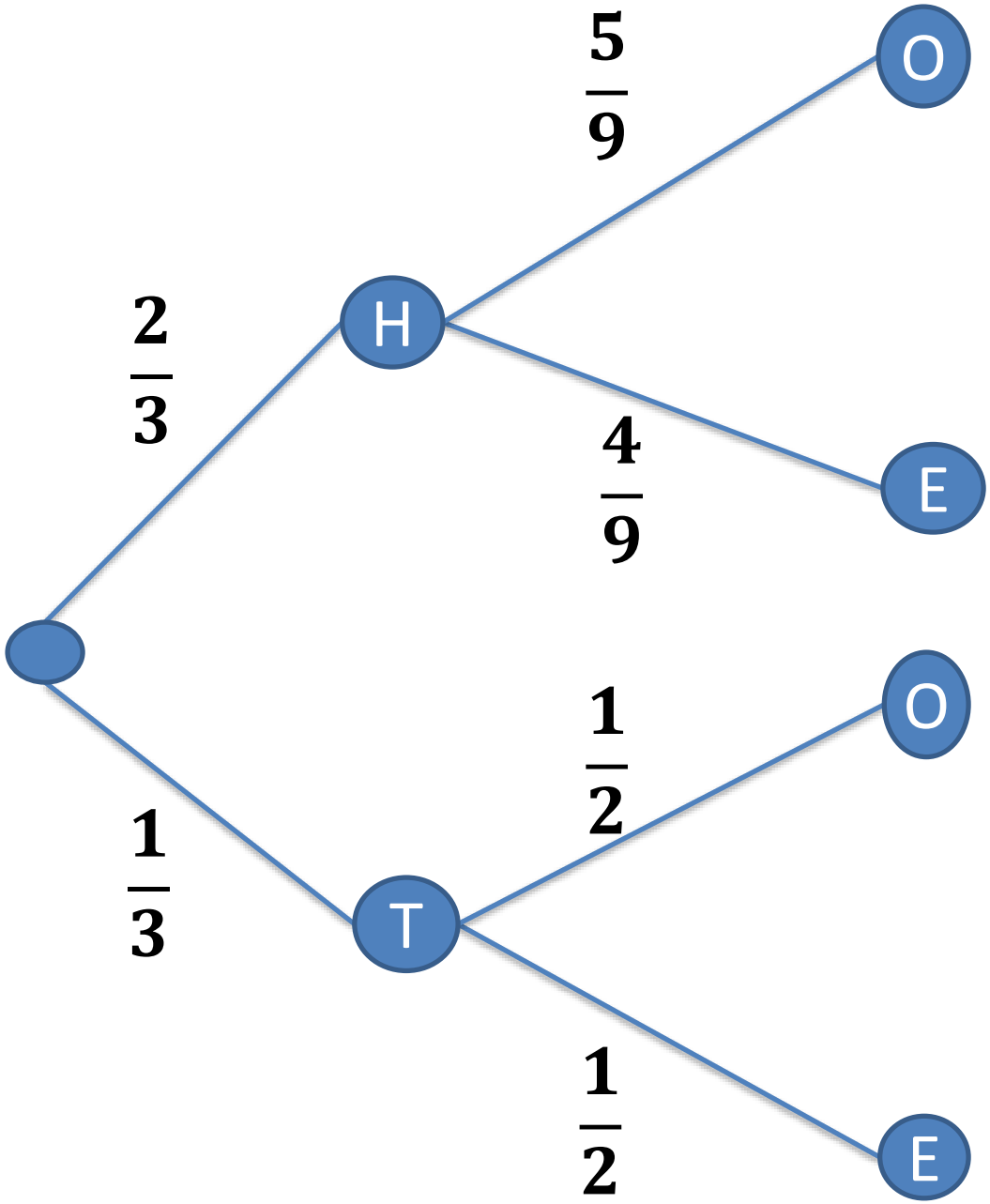

D
2/5
1
N
1/3
3/5
1/6
D
1/3
2
N
5/6
1/3
3/8
D
3
5/8
N

Thus by the multiplication theorem,

$$\mathbf{p} = \left(\frac{1}{3}\right)\left(\frac{2}{5}\right)+\left(\frac{1}{3}\right)\left(\frac{1}{6}\right)+ \left(\frac{1}{3}\right)\left(\frac{5}{8}\right) = \mathbf{\frac{113}{360}}$$

Example : A coin, weighted so that **P(H) =** $\frac{2}{3}$ and **P(T) =** $\frac{1}{3}$**,** is tossed. If **heads** appears, then a number is selected at random from the numbers **1 through 9**; if **tails** appears, then a number is selected at random from the numbers **1 through 6.**

Find the probability p that an **even number** is selected.


$\frac{5}{9}$
O
$\frac{2}{3}$
H
$\frac{4}{9}$
E
$\frac{1}{2}$
O
$\frac{1}{3}$
T
$\frac{1}{2}$
E

Probability of even using 1 through 9:

$P(E) = \frac{4}{9}$

Probability of even using 1 through 6:

$P(E) = \frac{3}{6} = \frac{1}{2}$

$\mathbf{p} = (\frac{2}{3})(\frac{4}{9})+(\frac{1}{3})(\frac{1}{2}) = \mathbf{\frac{25}{54}}$