

AI110 Assignment 1

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Question:

10.13.3.25: A coin is tossed 3 times. List the possible outcomes. Find the probability of getting (i) all heads (ii) at least 2 heads

Solution:

The possible outcomes may be listed as follows:

$$\begin{pmatrix} H, H, T & H, H, H \\ H, T, H & H, T, T \\ T, H, T & T, H, H \\ T, T, H & T, T, T \end{pmatrix}$$

The sample space S has a total of eight cases.

(i).

In order to solve this questions let us take a random variable x to represent the number of heads we get in three coin tosses and to explore all the events let us create a table to display the probabilities for varying values of x .

x	P(x)	Cases
0	$\frac{1}{8}$	$\{T, T, T\}$
1	$\frac{3}{8}$	$\{H, T, T\}, \{T, H, T\}, \{T, T, H\}$
2	$\frac{3}{8}$	$\{H, H, T\}, \{H, T, H\}, \{T, H, H\}$
3	$\frac{1}{8}$	$\{H, H, H\}$

The probability of getting all heads is clearly $\frac{1}{8}$.

Using binomial probability distribution we can say that $P(x) = \binom{n}{x}(P(H))^x(P(T))^{n-x}$.

Substituting n as 3 and x as 3 for the first part of the question we get $P(0) = (\frac{1}{2})^3 = \frac{1}{8}$.

(ii).

The probability of getting at least 2 heads or $P(x) \geq 2$ is equal to $\sum_{x=2}^n P(x)$.

Clearly $P(2) + P(3) = \frac{3}{8} + \frac{1}{8} = \frac{4}{8}$

Using binomial probability distribution to confirm probabilities we can say that $P(x) = \binom{n}{x} (P(H))^x (P(T))^{n-x}$.

Substituting n as 3 and x as 2 and n as 3 and x as 3 for the second case we get $P(2) + P(3) = \binom{3}{2} (\frac{1}{2})^2 (\frac{1}{2})^1 + (\frac{1}{2})^3 = \frac{1}{2}$.

The probability of getting at least 2 heads is therefore $\frac{1}{2}$.