Assignment 2

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1 PROBLEM

For each element in a set of size 2n, an unbiased coin is tossed. The 2n coin tosses are independent. An element is chosen if the corresponding coin toss were head. The probability that exactly n elements are chosen is:

(A) $\frac{^{2n}C_n}{4^n}$ (B) $\frac{^{2n}C_n}{2^n}$ (C) $\frac{1}{^{2n}C_n}$ (D) $\frac{1}{2}$

2 SOLUTION

The number of elements chosen is equal to the number of heads obtained by 2n coin tosses. Let X be a random variable with value of X equal to the number of heads obtained.

Probability of getting a head, $p = \frac{1}{2}$

Probability of getting a tail, $q = \frac{1}{2}$

Probability that n elements are chosen out of 2n elements is $\Pr(X = n)$

From binomial distribution we know that,

$$\Pr(X = r) = {}^nC_r p^r q^{n-r} \tag{2.0.1}$$

$$\Pr(X = n) = {}^{2n}C_n \times \left(\frac{1}{2}\right)^n \times \left(\frac{1}{2}\right)^n \tag{2.0.2}$$

$$= \frac{^{2n}C_n}{4^n} \tag{2.0.3}$$

Hence option (A) is correct.