AI1103 - Assignment - 1

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Question - 5.5

If each element of a second order determinant is either zero or one , what is the probability that the value of the determinant is positive ? (Assume that the individual entries are chosen independently each value being assumed with probability 1/2)

Solution :

Total number of entries in a second order determinant are 4 . Each value can be either 1 or 0 with a probability 1/2 . Let us assume that the entries of the matrix be a,b,c,d in the order respectively.

$$\text{Matrix M} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

For the determinant of the matrix M = (a*d - b*c) to be positive with possibilities as 1 or 0 both a and d should be 1 and at least one among b and c should be 0 .

Probability of both a and d to be 1 is 1/4.
Probability of at least one among b and c not equal to 1 is 3/4.

Therefore the required probability for the determinant of the matrix to be positive is

$$= 1/4 * 3/4$$
$$=3/16$$