

# Assignment

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Question 12.13.3.6 Explain why the experiment of tossing a coin three times is said to have binomial distribution

**Solution:** let  $X$  be the event of tossing coin and bernoulli distribution is

$$\Pr(X = k) = \begin{cases} q = 1 - p & k = 0 \\ p & k = 1 \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

(2)

Then the Z transform of X is

$$M_X(z) = E[z^{-X}] = \sum_{k=-\infty}^{\infty} \Pr(X = k) z^{-k} \quad (3)$$

$$= qz^0 + pz^{-1} \quad (4)$$

$$= q + pz^{-1} \quad (5)$$

Then for n trials,

$$M_X(z) = (pz^{-1} + q)^n \quad (6)$$

$$= \sum_{k=0}^n {}^nC_k (pz^{-1})^k q^{n-k} \quad (7)$$

$$= \sum_{k=0}^n {}^nC_k (p)^k (1-p)^{n-k} z^{-k} \quad (8)$$

By comparing Coefficients of  $z^{-k}$ ,

$$p_X(k) = {}^nC_k p^k (1-p)^{n-k} \quad 0 \leq k \leq n \quad (9)$$

which is a binomial distribution

$\therefore$  Tossing 3 coins also has a binomial distribution