# 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

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

$$\tag{2}$$

Then the Z transform of X is

$$M_X(z)=E[z^{-X}]=\sum_{k=-\infty}^{\infty} p_X(k)\,z^{-k} \tag{3}$$

$$=qz^{0}+pz^{-1} \tag{4}$$

$$=q+pz^{-1} \tag{5}$$

Then for n trials,

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

$$=\sum_{r=0}^{n} {}^{n}C_r\left(pz^{-1}\right)^{r} q^{n-r} \tag{7}$$

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

$$p_X(r)={}^{n}C_r p^{r}(1-p)^{n-r} \tag{8}$$

which is a binomial distribution

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