Q: It is known that 10% of certain articles manufactured are defective. What is the probability that in a random sample of 12 such articles, 9 are defective?
**Solution:** :

| Parameter | Values | Description |
|---|---|---|
| $n$ | 12 | Number of articles |
| $k$ | 9 | Number of defective articles |
| $p$ | 0.1 | Probability of being defective |
| $X$ | 1 if defective<br>0 if not defective | Bernoulli Random Variable |
| $Y$ | $\sum_{i=1}^{n} X_i$ | Binomial Random Variable |

TABLE 0
TABLE 1

Since the $X_i$ are IID, the pmf of $Y$ is given by

$$Y \sim \text{Bin}\,(n, p) \tag{1}$$

$$p_Y(k) = \Pr(Y = k) \tag{2}$$
$$= {}^{n}C_k p^k (1-p)^{n-k}, (1 \le k \le n) \tag{3}$$

We require $\Pr(Y = 9)$. Since $n = 12$,

$$\Pr(Y = 9) = p_Y(9) \tag{4}$$
$$= {}^{n}C_k p^k (1-p)^{n-k} \tag{5}$$
$$= 22\left(\frac{9^3}{10^{11}}\right) \tag{6}$$