Multinomial Distribution :-

A binomial experiment becomes multinomial if we let each trial have more than two possible outcomes.

⇒ The outcomes of each trial may be classified into one of k mutually exclusive categories $C_1, C_2, \ldots C_k$.

⇒ The probability of the i^{th} outcome is P_i which remains constant and $\Sigma p_i = 1$.

⇒ The successive trials are all independent.

⇒ The experiment is repeated a fixed number of times.

$$P(X_1 = x_1, X_2 = x_2, \ldots X_k = x_k) = \binom{n}{x_1\ x_2 \ldots x_k} P_1^{x_1} P_2^{x_2} \ldots P_k^{x_k}$$

where

$$\binom{n}{x_1\ x_2 \ldots x_k} = \frac{n!}{x_1!\, x_2! \ldots x_k!}$$

⇒ It has parameters $n, P_1, P_2, \ldots, P_k$

Examples :-

⇒ An accident may result in no injury, minor injury, severe injury or fatal injury.

⇒ Manufactured items may be classified as good, average or inferior.

⇒ Its Mean $= np_i$ and $var(x_i) = np_i q_i$

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Example 8.27 :- Pg 329.

A box contains 5 red, 4 white and 3 blue marbles. A sample of six marbles is drawn with replacement. Find the probability that out of 6 marbles 3 are red, 2 are white and one is blue.

Solution :-

Let X_1 : Red Marbles

X_2 : White Marbles

X_3 : Blue Marbles then

R	W	B	Total
5	4	3	=12

$P_1 = P(X_1 = 3) = 5/12$

$P_2 = P(X_2 = 2) = 4/12$

$P_3 = P(X_3 = 1) = 3/12$

$$P(X_1 = 3, X_2 = 2, X_3 = 1) = \frac{6!}{3!\,2!\,1!}\left(\frac{5}{12}\right)^3\left(\frac{4}{12}\right)^2\left(\frac{3}{12}\right)^1$$

$$= \frac{625}{5184}$$

Ans

Example 5.7 (Walpole) Pg 150

Example 2.41, 2.42 (Gartia) Pg 63

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Geometric Distribution:-

When an experiment consists of independent trials with 'p' probability of success and the trials are repeated until the first success occurs, it is called geometric experiment.

⇒ The outcomes of each trial may be classified into one of two categories success and failure.

⇒ The probability of success remains constant for all trials.

⇒ The successive trials are all independent.

⇒ The experiment is repeated a variable number of times until the first success occurs.

$$P(X=x) = pq^{x-1} \qquad x = 1, 2, \ldots$$

X: no of trials required upto and including the first success.

⇒ It has only one parameter p and denoted by $g(x; p)$

⇒ Also called waiting time random variable.

⇒ Its Mean and variance

$$\mu = \frac{1}{p}, \quad \sigma^2 = \frac{q}{p^2}$$

Example 8-26 (Pg 326) Sher M. Chaudhry

Example 5.16 (Pg 160) Walpole

Example 2.43 (Pg 64) Gartia.

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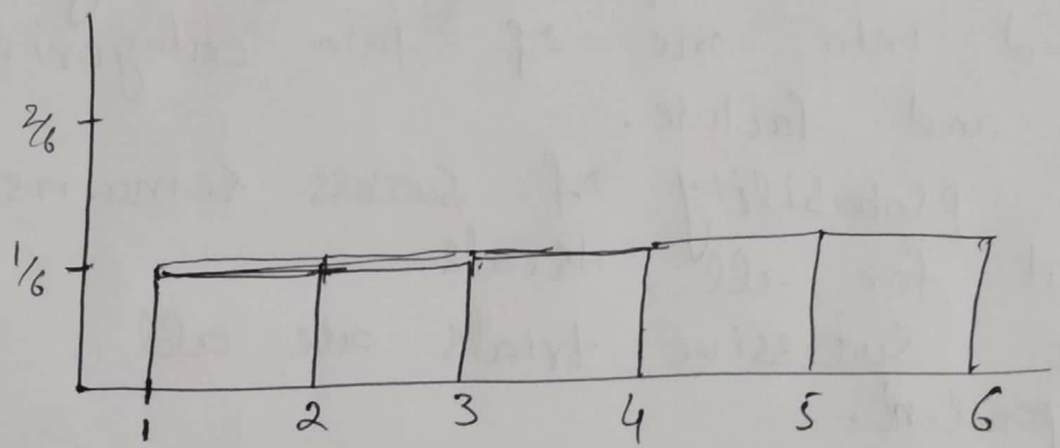
Discrete uniform distribution:-

⇒ which has all outcomes equally likely.

e.g when we roll a 6-sided dice, each side is equally likely to occur.

X: Roll of a fair 6-sided dice



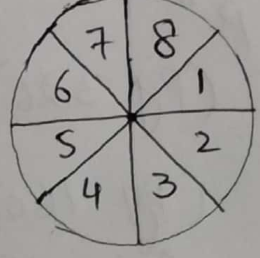
$$f(x) = \frac{1}{K}$$ [We have K values with equal probabilities]

$$\text{Mean} = \frac{K+1}{2}$$

$$\text{Variance} = \frac{K^2-1}{12}$$

Question Spinner game

Revolve a Spinner, the wheel has numbered 1 to 8. Each number corresponds to a gift. Suppose the number 8 corresponds to the most valuable gift and 1 corresponds to least valueable gift.



Equal size sectors.

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What percentage of times a player gets the most valueable prize.

$$f(x) = \frac{1}{K}$$

$$P(X=8) = \frac{1}{8} = 0.125$$

So $0.125 \times 100 = 12.5\%$ times a player gets the most valueable prize.

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