# DISCRETE UNIFORM DISTRIBUTION

Presented
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Definition:

*A discrete random variable X is said to have a uniform distribution on n points,* $\{x_1, x_2, \ldots\ldots, x_n\}$, *if its p.m.f. is given by:*

$$f(x) = \frac{1}{n}, \; x = x_1, x_2, \ldots\ldots\ldots, x_n$$

$$= 0 \quad , \text{otherwise}$$

*In particular, if* $x_i = i; i = 1,2,\ldots\ldots\ldots, n$, *p.m.f. will be*

$$f(x) = \frac{1}{n}, \; x = 1,2,\ldots\ldots\ldots, n$$

$$= 0 \quad , \text{otherwise}$$

*The number of points that shows up in rolling a fair die follows uniform distribution with p.m.f*

$$f(x) = \frac{1}{6}, \; x = 1,2,\ldots\ldots,6$$

$$= 0 \quad , \; otherwise$$

*The cumulative distribution function of X is given by*

$$F(x) = P(X \le k) = \frac{k}{n}$$

*k being the number of variate values smaller than or equal to* $x; \; k = 0,1,\ldots.,n.$

# MEAN AND VARIANCE

*The mean and variance of the uniform random variable assuming the values* $x_1, x_2, \ldots\ldots, x_n$ *are as follows:*

$$Mean, \mu = E(X) = \sum_{i=1}^{n} x_i . \frac{1}{n} = \bar{x}$$

$$Variance, \sigma^2 = V(X) = E(X^2) - E^2(X)$$

$$= \sum_{i=1}^{n} x_i^2 . \frac{1}{n} - \bar{x}^2 = \frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2$$

$$\text{If } x_i = i; i = 1,2,\ldots\ldots, n; \text{ then } \mu = E(X) = \frac{n+1}{2} \text{ and}$$

$$\sigma^2 = V(X) = \frac{(n+1)(2n+1)}{6} - \left(\frac{n+1}{2}\right)^2 = \frac{n^2-1}{12}$$

$$\text{Standard deviation} = \sigma = \sqrt{V(X)} = +\sqrt{\frac{n^2-1}{12}}.$$

Problem:

$Suppose\ that\ a\ discrete\ random\ variable\ X$

$assuming\ the\ values\ 0, 5, 10, 15, 20, 25, 30$

$follows\ uniform\ distrubution.$

$Obtain\ the\ probability\ that\ X\ takes\ the\ value: -$

$i)\ 0,\ ii)\ 2,\ iii)\ less\ than\ 10,\ iv)\ 10\ or\ less,\ v)\ 10\ or\ more,$

$vi)\ less\ than\ 5.5.$

$What\ are\ the\ mean\ and\ standard\ deviation\ of\ the$

$distribution?$

**Solution:**

$$P(X=x)=\frac{1}{7},\forall x$$

$$i)\ P(X=0)=\frac{1}{7},\ ii)\ P(X=2)=\frac{1}{7}$$

$$iii)\ P(X<10)=P(X=0)+P(X=5)=\frac{2}{7}$$

$$iv)\ P(X\le 10)=P(X=0)+P(X=5)+P(X=10)=\frac{3}{7}$$

$$v)\ P(X\ge 10)=1-P(X<10)=1-\frac{2}{7}=\frac{5}{7}$$

$$vi)\ P(X < 5.5) = P(X = 0) + P(X = 5) = \frac{2}{7}$$

$$E(X) = \sum_x x.P(X = x)$$

$$= \frac{1}{7}[0+5+10+15+20+25+30] = \frac{105}{7} = 15$$

$$E(X^2) = \sum_x x^2.P(X = x)$$

$$= \frac{1}{7}[0+5^2+10^2+15^2+20^2+25^2+30^2]$$

$$=\frac{5^2}{7}[1^2+2^2+3^2+4^2+5^2+6^2]$$

$$=\frac{5^2*6*(6+1)(2*6+1)}{7*6}$$

$$=13*25=325$$

$$V(X)=E(X^2)-E^2(X)\;=325-15^2=100$$

$$\boxed{S.D.=\sqrt{100}=10}$$

Thank you…………