Mean and variance of a discrete distribution

Aim :

To find mean and variance of arrival of objects from the feeder using probability distribution

Software required :

Python and Visual components tool

Theory:

The expectation or the mean of a discrete random variable is a weighted average of all possible values of the random variable. The weights are the probabilities associated with the corresponding values. It is calculated as,

$$E(X) = \mu = \Sigma_i x_i p_i \qquad i = 1, 2, \ldots, n$$

$$E(X) = x_1p_1 + x_2p_2 + \ldots + x_np_n.$$

The variance of a random variable shows the variability or the scatterings of the random variables. It shows the distance of a random variable from its mean. It is calcualted as

$$\sigma_x^2 = \text{Var}(X) = \sum_i (x_i - \mu)^2 \, p(x_i) = E(X - \mu)^2 \text{ or, } \text{Var}(X) = E(X^2) - [E(X)]^2.$$

$$E(X^2) = \sum_i x_i^2 \, p(x_i), \text{ and } [E(X)]^2 = [\sum_i x_i \, p(x_i)]^2 = \mu^2.$$

Procedure :

1. Construct frequency distribution for the data
2. Find the probability distribution from frequency distribution.
3. Calculate mean using

$$\mathbf{E(X) = \mu = \Sigma_i \, x_i \, p_i \qquad i = 1, 2, \ldots, n}$$

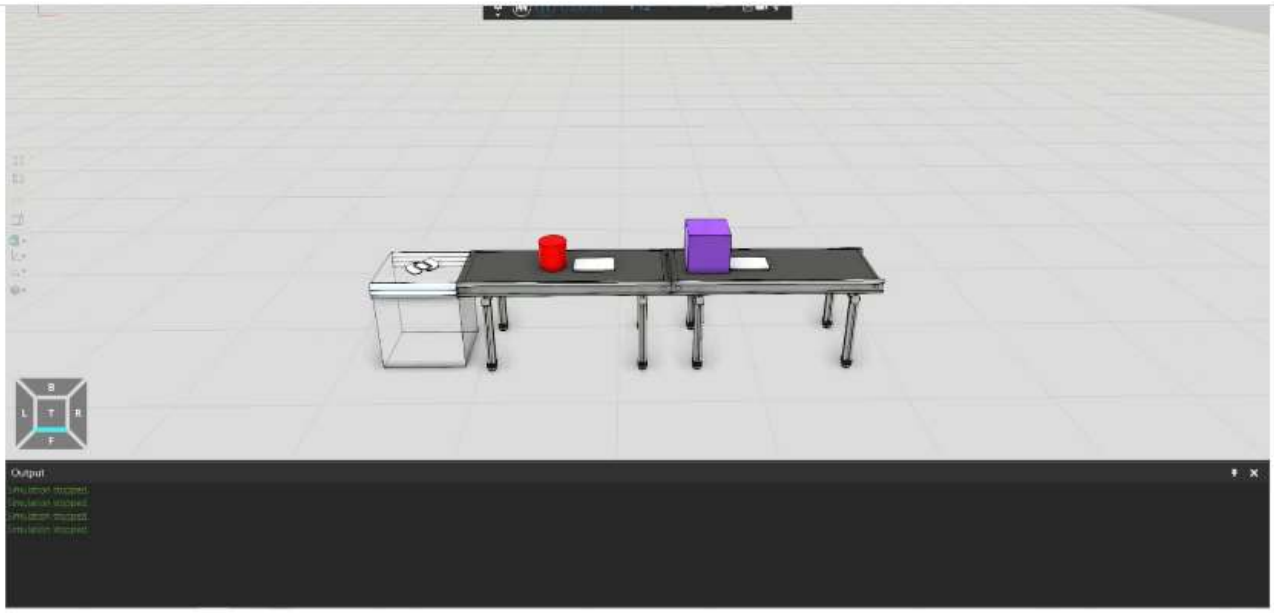
4. Find

$$E(X^2) = \sum_i x_i^2 \, p(x_i)$$

5. Calculate variance using

$$\text{Var(X)} = E(X^2) - [E(X)]^2$$

Experiment :



Program :

```
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import numpy as np
L=[int(i) for i in input().split()]
N=len(L);M=max(L)
X=list();f=list()
for i in range(M+1):
    c=0
    for j in range(N):
        if L[j]==i:
            c=c+1
    f.append(c)
    X.append(i)
sf=np.sum(f)
p=list()
for i in range(M+1):
    p.append(f[i]/sf)
mean=np.inner(X,p)
EX2=np.inner(np.square(X),p)
var=EX2-mean**2
SD=np.sqrt(var)
print("The mean arrival rate is %.3f"%mean)
print("The variance of arrival from feeder is %.3f"%var)
print("The standard deviation of arrival deom feeder is %.3f"%SD)
```

Output :

```
Enter numbers: 1 8 0 5 9 6 7 9 4 6 2 3
The Mean arrival rate is 5.000
The Variance of arrival from feeder is 8.500
The Standard deviation of arrival from feeder is 2.915
```

Results :

The mean and variance of arrivals of objects from feeder using probability distribution are calculated.

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