

# Forward School

**## Program Code: J620-002-4:2020**

**## Program Name: FRONT-END SOFTWARE DEVELOPMENT**

**## Title : Exe14 - Poisson Distribution Exercise**

**#### Name: Ooi Caaron**

**#### IC Number: 990701-07-5837**

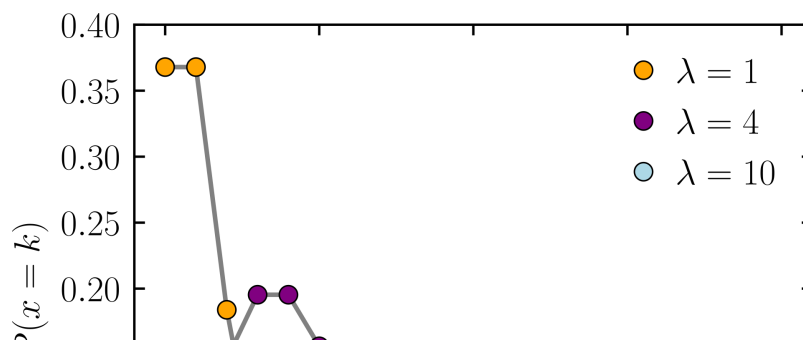
**#### Date : 16/7/2023**

**#### Introduction : Learning the binomial distribution using the built in method to plot the graph**

**#### Conclusion :Still need to practice more and do revision**

## Poisson Distribution

A Poisson Distribution gives the probability of an event happening based on an average occurrence of that event over a period of time or a large volume.



In [2]:

```
from scipy.stats import poisson
import numpy as np
poisson.pmf(7,10)
1-poisson.cdf(10,10)
poisson.pmf(3,1.6)
poisson.cdf(3,1.6)
poisson.cdf(4,7)
1-poisson.cdf(10,7)
poisson.pmf(np.arange(5,16),7).sum()
poisson.cdf(15,7) - poisson.cdf(4,7)
```

Out[2]:

0.8246018117705305

## Question 1

Suppose a baseball player has a  $p=.300$  batting average. What is the probability of:

- $P(X \leq 150)$  hits in  $n=500$  at bats
- $P(X=150)$
- $P(X > 150)$

In [3]:

```
p1 = poisson.cdf(150,150)
p2 = poisson.pmf(150,150)
p3 = 1-p1

print(p1,p2,p3)
```

0.5216971797074769 0.03255540945683085 0.47830282029252313

## Question 2

What is the probability of making 2 to 4 sales in a week if the average sales rate is 3 per week?

In [4]:

```
sum(poisson.pmf(np.arange(2,5),3))
```

Out[4]:

0.6161149710523164

## Question 3

Patients arrive at hospital accident and emergency department at random at a rate of 6 per hour

Find the probability that during any 90 minute period, the number of patients arriving at the hospital accident and emergency department is:

- exactly 7
- at least 10

In [5]:

```
s = poisson.pmf(7,9)
t = 1 - poisson.cdf(9,9)
print(s,t)
```

```
0.1171161244529091 0.4125917556680583
```

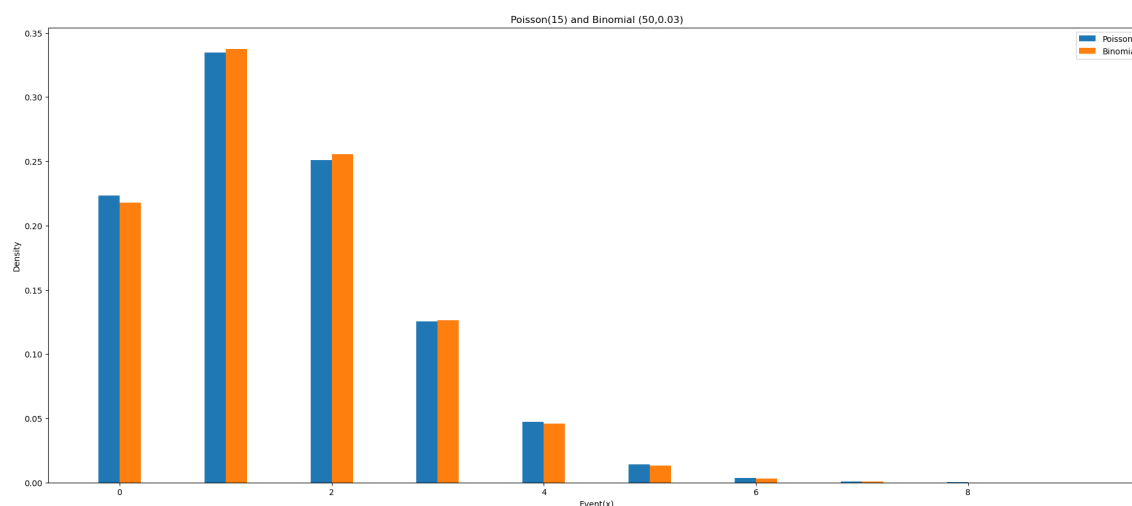
## Question 4

What is the distribution of successes from a sample of  $n = 50$  when the probability of success is  $p = 0.03$  for both binomial and poisson distributions. Plot the barplot to visualize.

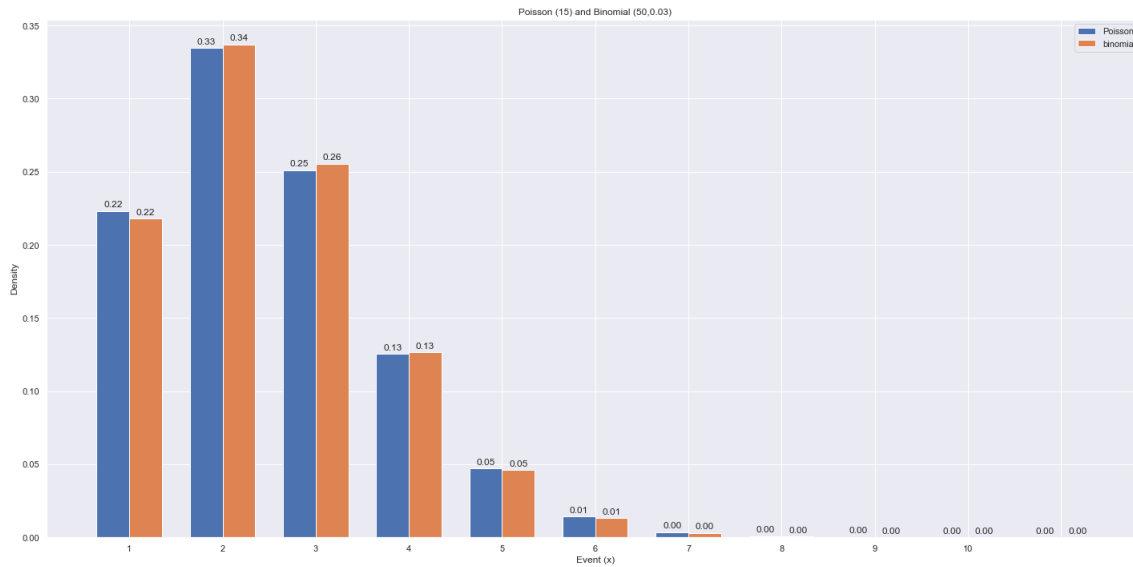
In [6]:

```
import matplotlib.pyplot as plt
import numpy as np
from scipy.stats import binom

a = np.arange(0,10)
b = poisson.pmf(a,1.5)
c = binom.pmf(a,50,0.03)
plt.figure(figsize=(24,10))
bar1 = plt.bar(a-0.1, b, width=0.2)
bar2 = plt.bar(a+0.1, c, width=0.2)
plt.xlabel('Event(x)')
plt.ylabel('Density')
plt.title('Poisson(15) and Binomial (50,0.03)')
plt.legend((bar1,bar2),('Poisson','Binomial'))
plt.show()
```



In [1]:



## Question 5

Suppose the probability that a drug produces a certain side effect is  $p = 0.1\%$  and  $n = 1,000$  patients in a clinical trial receive the drug. What is the probability 0 people experience the side effect?

In [7]:

```
# 3.7200759
poisson.pmf(0, 1000*0.1)
```

Out[7]:

```
3.720075976020836e-44
```

## Question 6

If there are twelve cars crossing a bridge per minute on average, find the probability of having eighteen or more cars crossing the bridge in a particular minute.

In [8]:

```
# 0.062966
1 - poisson.cdf(17, 12)
```

Out[8]:

```
0.06296629677397025
```

## Question 7

If a bird flies overhead at an average rate of 1 every 4 hours, what is the probability that at least one bird will fly overhead in the next hour?

In [9]:

```
# 0.221199  
1 - poisson.pmf(0, 1/4)
```

Out[9]:

0.22119921692859512

## Question 8

A New York Times article in 2012 found that on average 24 horses die on US racetracks each week and from 2009 to 2012 and the US logged 5.2 incidents per 1,000 starts. Calculate the probability of getting 30 or more fatalities in one week. (Hints: 4 years, 1000 starts)

In [10]:

```
1 - poisson.cdf(29, 24)
```

Out[10]:

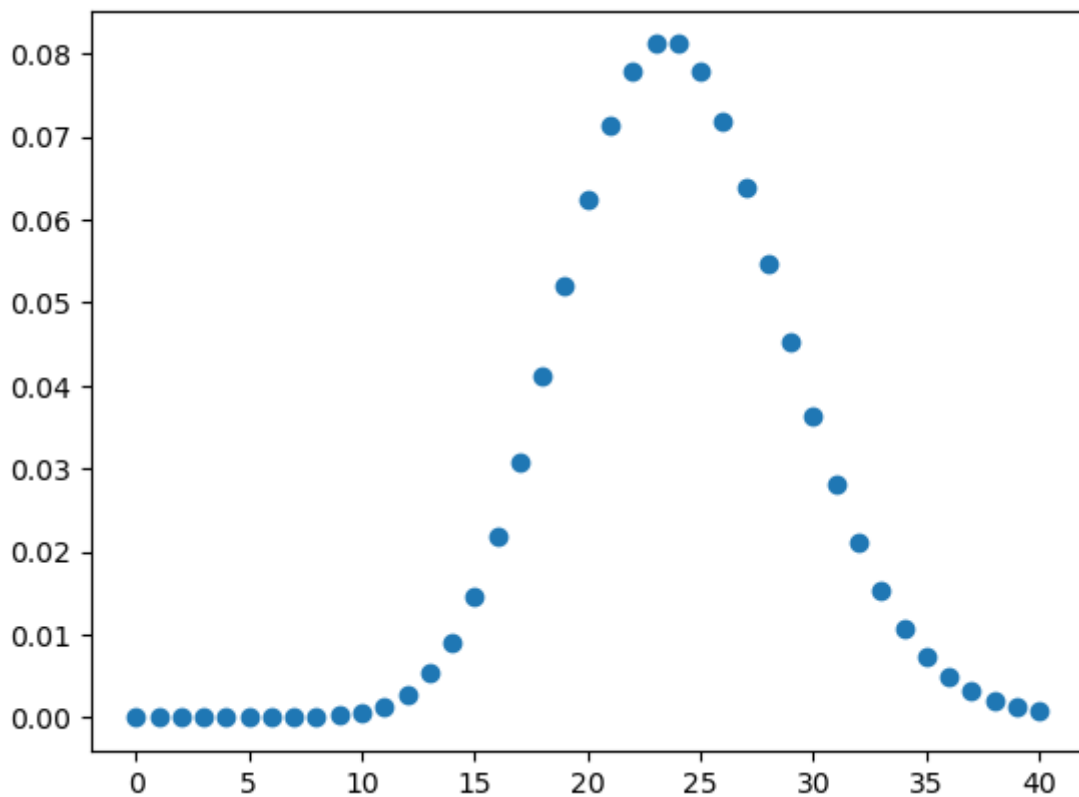
0.13212358467196939

## Question 9

Continuing from Question 8, calculate the probability that between 0 and 40 horses will die in a week. Plot a scatter plot to visualize it.

In [11]:

```
x=np.arange(0,41)
y = poisson.pmf(x,mu=24, loc=0)
plt.scatter(x,y)
plt.show()
```



## Question 10

Based on probability of that 30 or more horses will die in one week, calculate the total number of times in a year that 30 or more horses will die in a year.

In [12]:

```
# 0.999629
poisson.sf(29,52)
```

Out[12]:

```
0.9996296398778977
```