

How can the Poisson distribution be utilized in Python?

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The Poisson distribution is a mathematical concept that describes the probability of a certain number of events occurring within a specific time interval. In Python, the Poisson distribution can be utilized to model and analyze various real-world phenomena, such as the number of customers visiting a store in a given time period or the number of accidents on a specific stretch of road. By using the built-in functions and methods available in Python, users can easily generate random numbers following the Poisson distribution, calculate the probability of a specific event occurring, and visualize the distribution using various plotting tools. This allows for efficient and effective data analysis and prediction in a wide range of fields, including statistics, economics, and engineering.

Use the Poisson Distribution in Python

The describes the probability of obtaining k successes during a given time interval.

If a random variable X follows a Poisson distribution, then the probability that $X = k$ successes can be found by the following formula:

$$P(X=k) = \frac{\lambda^k * e^{-\lambda}}{k!}$$

where:

λ : mean number of successes that occur during a specific interval
 k : number of successes
 e : a constant equal to approximately 2.71828

This tutorial explains how to use the Poisson distribution in Python.

How to Generate a Poisson Distribution

You can use the `poisson.rvs(mu, size)` function to generate random values from a Poisson distribution with a specific mean value and sample size:

```
from scipy.stats import poisson
```

```
#generate random values from Poisson distribution  
with mean=3 and sample size=10  
poisson.rvs(mu=3, size=10)
```

```
array()
```

How to Calculate Probabilities Using a Poisson Distribution

You can use the `poisson.pmf(k, mu)` and `poisson.cdf(k, mu)` functions to calculate probabilities related to the Poisson distribution.

Example 1: Probability Equal to Some Value

A store sells 3 apples per day on average. What is the probability that they will sell 5 apples on a given day?

```
from scipy.stats import poisson
```

```
#calculate probability  
poisson.pmf(k=5, mu=3)
```

0.100819

The probability that the store sells 5 apples in a given day is 0.100819.

Example 2: Probability Less than Some Value

A certain store sells seven footballs per day on average. What is the probability that this store sells four or less footballs in a given day?

```
from scipy.stats import poisson
```

```
#calculate probability  
poisson.cdf(k=4, mu=7)
```

0.172992

The probability that the store sells four or less footballs in a given day is 0.172992.

Example 3: Probability Greater than Some Value

A certain store sells 15 cans of tuna per day on average. What is the probability that this store sells more than 20 cans of tuna in a given day?

```
from scipy.stats import poisson
```

```
#calculate probability
```

```
1-poisson.cdf(k=20, mu=15)
```

```
0.082971
```

The probability that the store sells more than 20 cans of tuna in a given day is 0.082971.

How to Plot a Poisson Distribution

You can use the following syntax to plot a Poisson distribution with a given mean:

```
from scipy.stats import poisson
```

```
import matplotlib.pyplot as plt
```

```
#generate Poisson distribution with sample size 10000
```

```
x = poisson.rvs(mu=3, size=10000)
```

```
#create plot of Poisson distribution
```

```
plt.hist(x, density=True, edgecolor='black')
```

