Poisson distribution

Poisson Distribution

- Each occurrence is independent of the other.
- The occurrences in each interval can range from zero to infinity.
- The mean number of occurrences must be constant

Poisson Distribution Formula

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

where

x = 0, 1, 2, 3, …

λ = mean number of occurrences in the interval

e = Euler's constant $\approx$ 2.71828

Poisson Distribution in Python using SciPy package

scipy.stats.poisson¶

scipy.stats.poisson(**args, **kwds*) = *<scipy.stats._discrete_distns.poisson_gen object>* [source]

A Poisson discrete random variable.

As an instance of the rv_discrete class, poisson object inherits from it a collection of generic methods (see below for the full list), and completes them with details specific for this particular distribution.

Notes

The probability mass function for poisson is:

$$f(k) = \exp(-\mu) \frac{\mu^k}{k!}$$

for $k \geq 0$.

poisson takes μ as shape parameter.

Methods available in binom module

Methods

rvs(mu, loc=0, size=1, random_state=None)	Random variates.
pmf(k, mu, loc=0)	Probability mass function.
logpmf(k, mu, loc=0)	Log of the probability mass function.
cdf(k, mu, loc=0)	Cumulative distribution function.
logcdf(k, mu, loc=0)	Log of the cumulative distribution function.
sf(k, mu, loc=0)	Survival function (also defined as `1 - cdf`, but *sf* is sometimes more accurate).
logsf(k, mu, loc=0)	Log of the survival function.
ppf(q, mu, loc=0)	Percent point function (inverse of `cdf` — percentiles).
isf(q, mu, loc=0)	Inverse survival function (inverse of `sf`).
stats(mu, loc=0, moments='mv')	Mean('m'), variance('v'), skew('s'), and/or kurtosis('k').
entropy(mu, loc=0)	(Differential) entropy of the RV.
expect(func, args=(mu,), loc=0, lb=None, ub=None, conditional=False)	Expected value of a function (of one argument) with respect to the distribution.
median(mu, loc=0)	Median of the distribution.
mean(mu, loc=0)	Mean of the distribution.
var(mu, loc=0)	Variance of the distribution.
std(mu, loc=0)	Standard deviation of the distribution.
interval(alpha, mu, loc=0)	Endpoints of the range that contains alpha percent of the distribution

Poisson Distribution in Python

- Generating Number from Poisson Distribution

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

```
data=poisson.rvs(mu=5.5,size=100)
data
```

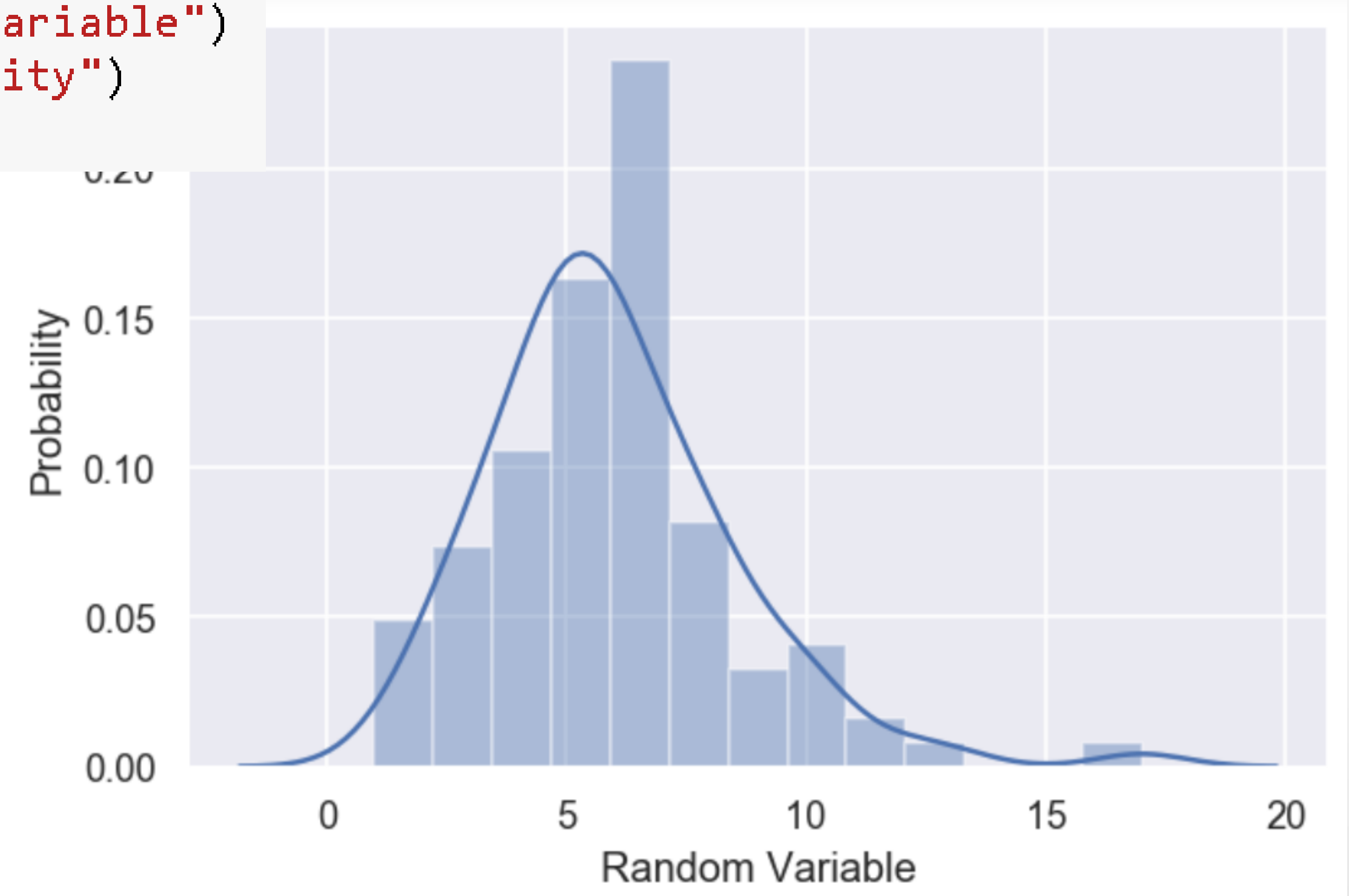
```
array([ 8,  6,  4, 10, 11,  2,  8,  5,  4,  9,  6,  5,  3,  5,  9,  1,  5,
        7,  3,  5,  5,  6,  4,  7,  5,  5,  7,  8,  3,  6,  8,  5,  6,  5,
        6,  8,  8,  7,  6,  6, 10,  5,  8,  5,  6,  9,  4,  2,  8,  4,  3,
        3,  8, 10,  5,  5,  6,  4,  7,  4,  4,  4,  6,  5,  5,  5,  7,  5,
        8,  7,  5, 13,  4, 10,  2,  3,  7,  6,  7,  2,  5,  6,  6,  7,  4,
       12,  2,  9,  6,  7,  3,  6,  3,  4,  3,  6, 10, 17,  4,  6])
```

```
np.unique(data,return_counts=True)
```

```
(array([ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 17]),
 array([ 1,  5,  9, 13, 20, 18, 11, 10,  4,  5,  1,  1,  1,  1],
       dtype=int64))
```

Plotting the Poisson Distribution

```
plt.figure(dpi=120)
sns.distplot(data)
plt.xlabel("Random Variable")
plt.ylabel("Probability")
plt.show()
```



Estimation of CDF and its inverse

```
In [69]: poisson.cdf(k=3,mu=5.5)

Out[69]: 0.20169919870252867
```

```
In [71]: #Percent point function (inverse of cdf – percentiles).
         poisson.ppf(q=0.2, mu=5.5)

Out[71]: 3.0
```