PYTHON DISTRIBUTIONS

Imports

```
import numpy as np
import scipy.stats as stats
import matplotlib.pyplot as plt
%matplotlib inline
import matplotlib as mpl
mpl.rcParams.update({
    'font.size': 20.0,
    'axes.titlesize': 'small',
    'axes.labelsize': 'small',
    'xtick.labelsize': 'small',
    'ytick.labelsize': 'small'
})
```

Plot Discrete Distribution

```
def plot_discrete(dist):
    fig, ax = plt.subplots(2, 1,
    sharex=True, figsize=(4, 5))
    # Plot hist
    rvs = dist.rvs(size=1000)
    w = np.ones_like(rvs)/
    float(len(rvs))
    ax[0].hist(rvs, weights=w,
    alpha=0.2, histtype='stepfilled')
    # Plot pmf.
    k = np.arange(dist.ppf(0.01),
    dist.ppf(0.99)+1)
    ax[0].plot(k, dist.pmf(k), 'bo',
    lw=2);
    ax[0].set_title(
    dist.dist.name.title() + ' PMF')
    ax[0].set_ylabel('p(X=k)')
    # Plot cdf.
    ax[1].plot(k, dist.cdf(k), 'bo',
    lw=2);
    ax[1].set_title(
    dist.dist.name.title() + ' CDF')
    ax[1].set_ylabel('p(X<=k)')
    ax[1].set_xlabel('k');
    return (fig, ax)
```

Plot Continuous Distribution

```
def plot_continuous(dist):
    fig, ax = plt.subplots(2, 1,
    sharex=True, figsize=(4, 5))
    # Plot hist
    rvs = dist.rvs(size=1000)
    ax[0].hist(rvs, normed=True,
    alpha=0.2, histtype='stepfilled')
```

Plot Continuous (Continued)

```
    # Plot pdf.
    x=np.linspace(dist.ppf(0.01),
    dist.ppf(0.99), 50)
    ax[0].plot(x, dist.pdf(x), '-',
    lw=2);
    ax[0].set_title(
    dist.dist.name.title() + ' PDF')
    ax[0].set_ylabel('p(X=x)')
    # Plot cdf.
    ax[1].plot(x, dist.cdf(x), '-', lw=2);
    ax[1].set_title(
    dist.dist.name.title() + ' CDF')
    ax[1].set_ylabel('p(X<=x)')
    ax[1].set_xlabel('x');
    return (fig, ax)
```

Bernoulli (Discrete)

Models

One instance of a success or failure trial, e.g. (possibly unfair) coin toss.

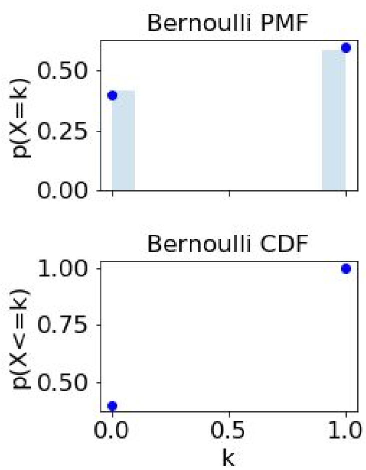
Parameters

p - probability of success.

k - failure or success, i.e. {0,1}, observation.

Create and Plot

```
bernoulli = stats.bernoulli(p=0.6)
plot_discrete(bernoulli)
```



Binomial (Discrete)

Models

Number of successes out of a number of Bernoulli trials **with** replacement., e.g. number of coin flips out of 100 that turn out to be heads.

Binomial (Continued)

Parameters

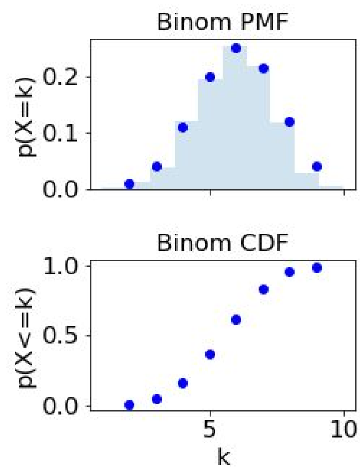
p - probability of success (each trial).

n - number of independent trials.

k - observed number of successes

Create and Plot

```
binomial=stats.binom(n=10,p=0.6)
plot_discrete(binomial)
```



Geometric (Discrete)

Models

Number of Bernoulli trials until first success, e.g. number of trials until coin flip turns out to be heads.

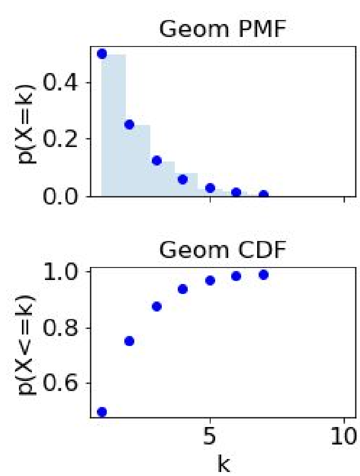
Parameters

p - probability of success (each trial).

k - observed trials until success.

Create and Plot

```
geometric = stats.geom(p=0.5)
plot_discrete(geometric)
```



Poisson (Discrete)

Models

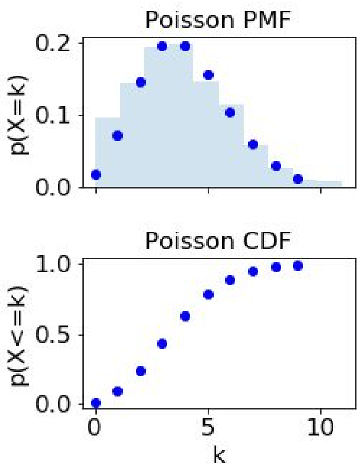
Number of events occurring in a fixed interval, e.g. number of taxis passing a street corner in a given hour (on avg. 10/hr).

Parameters

lambda - average number of independent events per interval.
k - events observed in an interval.

Create and Plot

lam = 4 # lambda
poisson = stats.poisson(mu=lam)
plot_discrete(poisson)



Exponential (Continuous)

Models

Time between poisson events, e.g. time until taxi will pass street corner.

Parameters

lambda - average number of independent events per interval.
x - observed time between events.

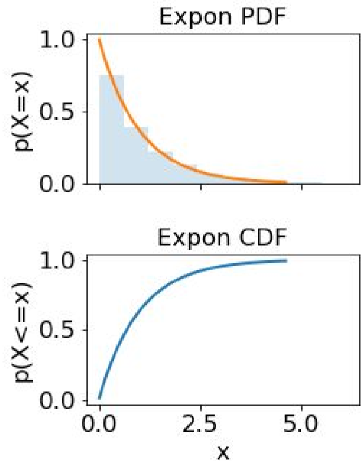
Create and Plot

lam = 1 # lambda
exponential =
stats.expon(scale=1/lam)
plot_continuous(exponential)

Central Limit Theorem

Means of random samples drawn from any distribution will have an approximately normal distribution.

Exponential (Continued)



Uniform (Continuous)

Models

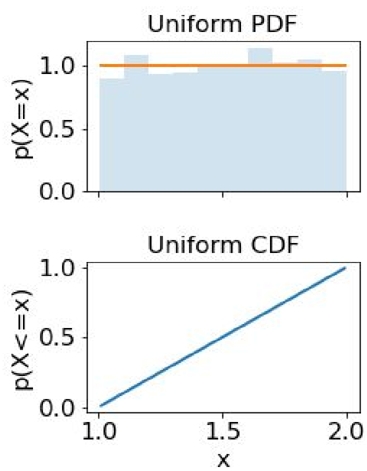
Equally likely outcomes in the interval a to b, e.g. degrees between hour and minute hand.

Parameters

a - minimum value.
b - maximum value.
x - observed value.

Create and Plot

a,b = 1,2
uniform = stats.uniform(loc=a, scale=b-a)
plot_continuous(uniform)



Gaussian (Continuous)

Models

A bell curve, e.g. IQ score.

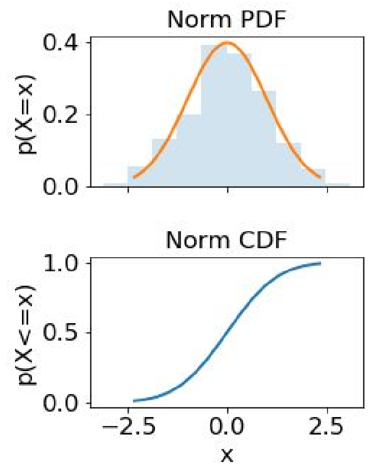
Gaussian (Continued)

Parameters

mu - mean or expectation.
sigma - standard deviation.
x - observed value.

Create and Plot

mu, sigma = 0, 1
gaussian=stats.norm(loc=mu,scale=sigma)
plot_continuous(gaussian)



Weibull (Continuous)

Models

Time between events when rate is **not** constant, e.g. time-to-failure when rate of failure increases or decreases over time.

Gamma (Continuous)

Models

Waiting time between Poisson distributed events. Used when waiting times between events are relevant, e.g. aggregate insurance claims or the amount of rainfall accumulated in a reservoir.

Hypergeometric (Discrete)

Models

Number of successes out of a number of success or failure trials **without** replacement, e.g. Number of times you draw a black ball from an urn of black and white balls without putting any back.