SIMULATION REPORT

Binomial Distribution:

The binomial distribution with parameters n and p is the discrete probability distribution of the number of successes in a sequence of n independent experiments.

First part:

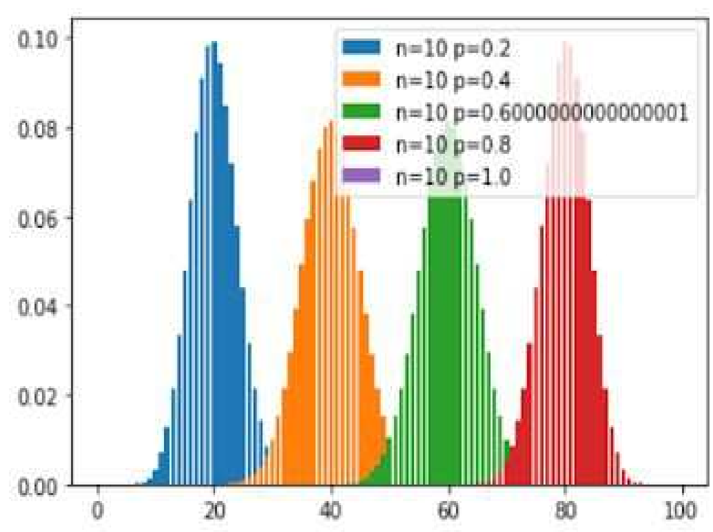
n, p are the parameters

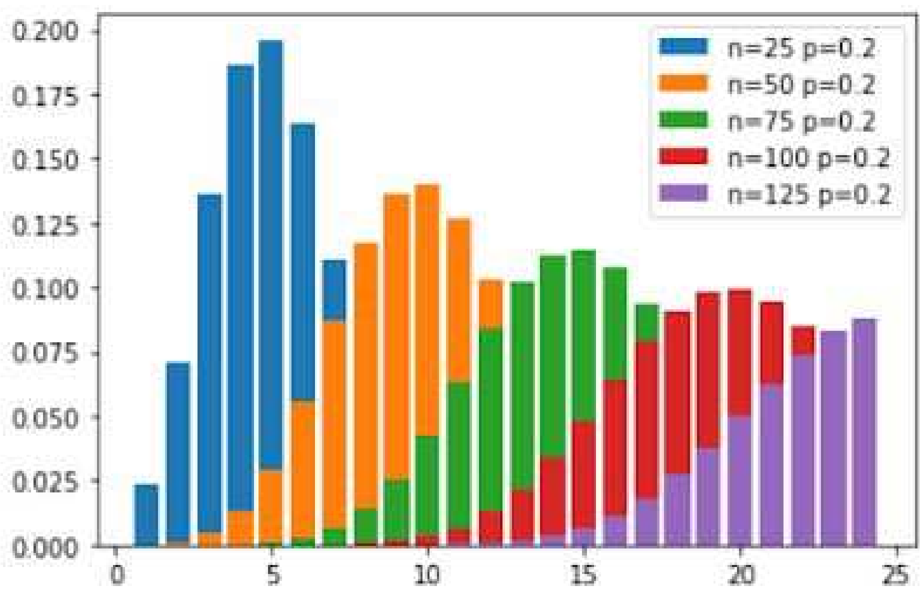
Using **Probability = [n!/(n-x)!(x!)]* p^x* (1-p)^(n-x)**

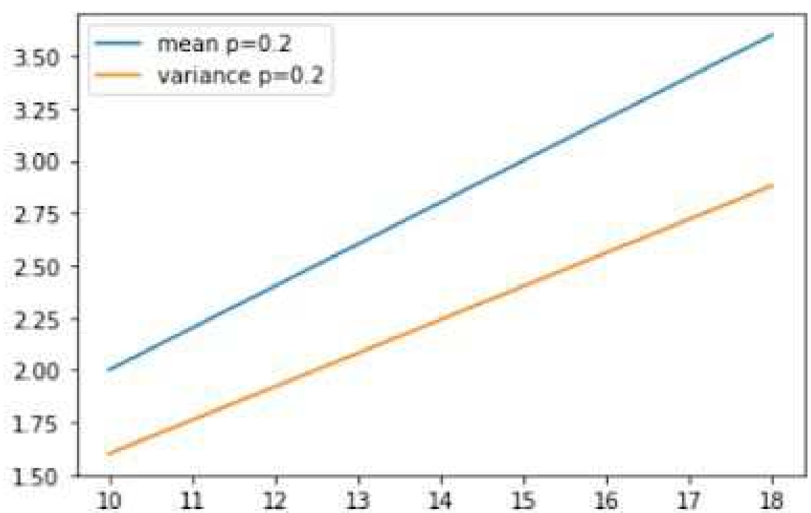
We plot the binomial distribution by changing the parameters n, p

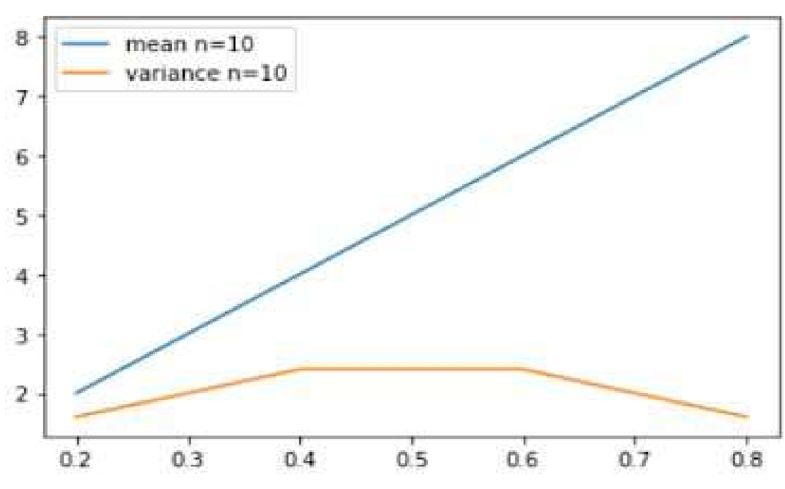
Using **mean= n*p, variance=np(1-p)**

We plot different graphs by changing mean and variance accordingly.

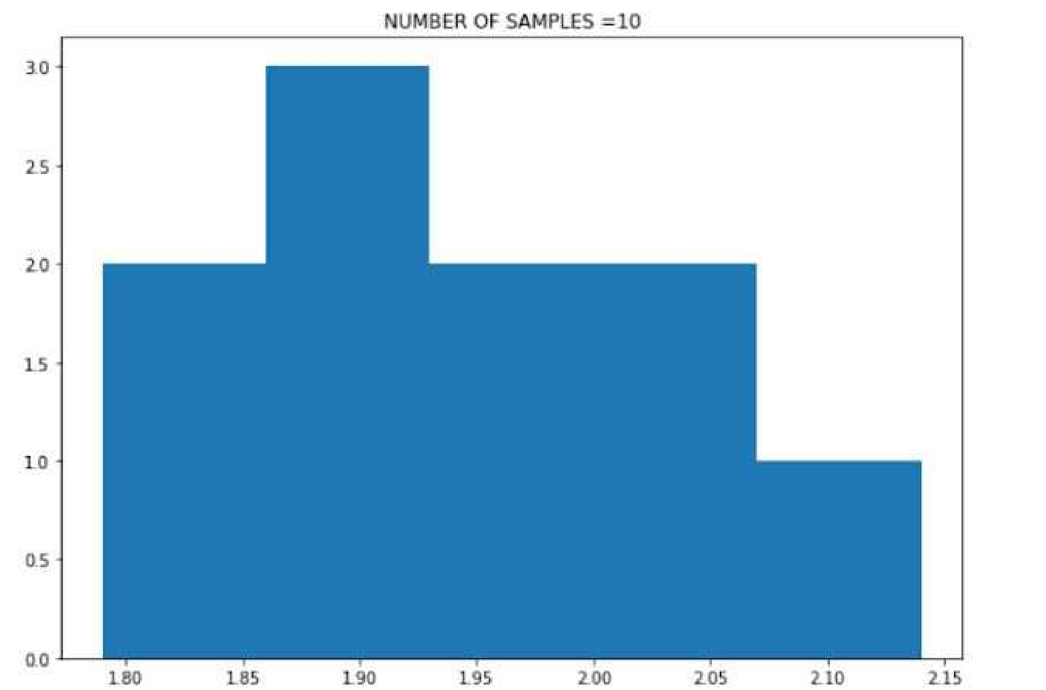


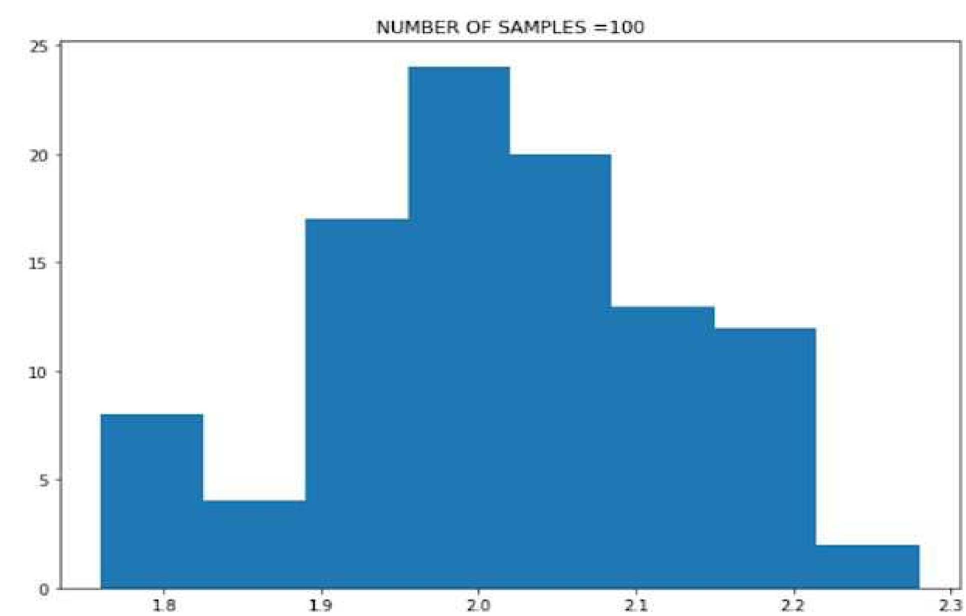

n=25 p=0.2
n=50 p=0.2
n=75 p=0.2
n=100 p=0.2
n=125 p=0.2
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0
5
10
15
20
25

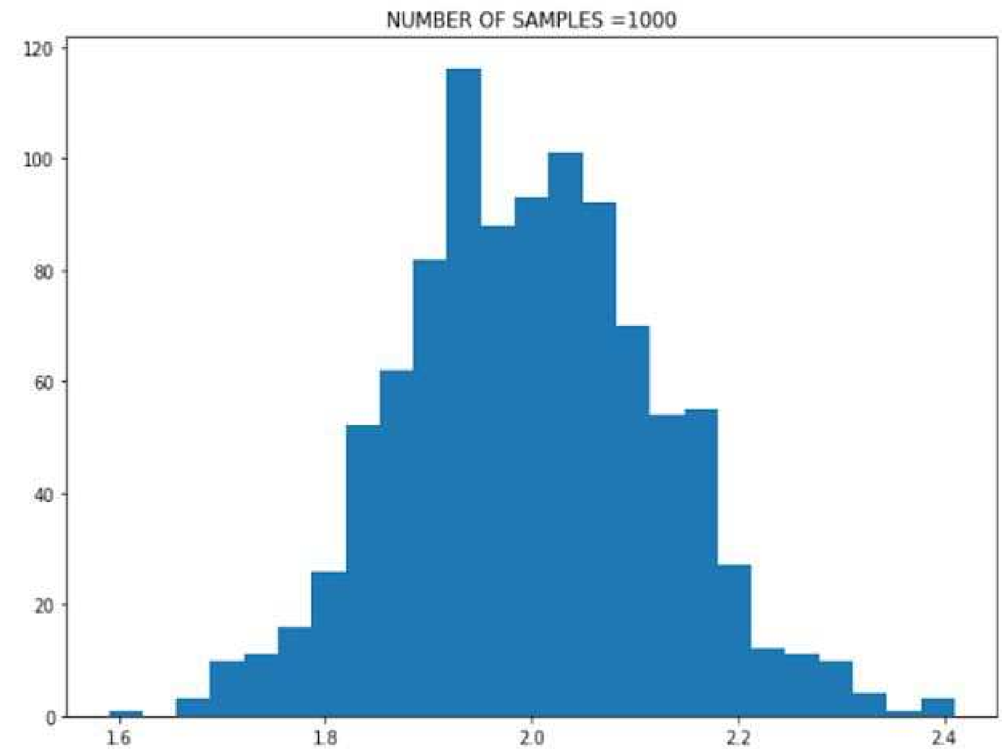

mean p=0.2
variance p=0.2
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
10
11
12
13
14
15
16
17
18

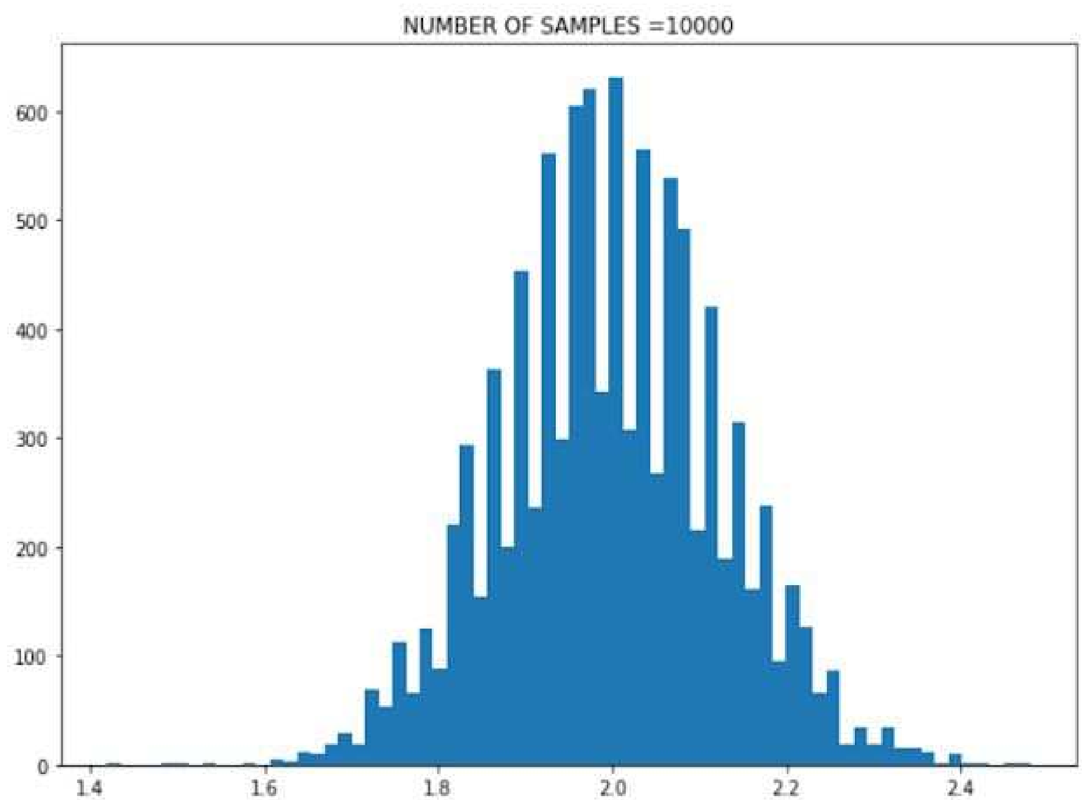

mean n=10
variance n=10
8
7
6
5
4
3
2
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Second part:
Plotting graph for 40 samples using the function
np.random.binomial(n,p,size)
Plotted graphs for different values of n and p and calculated mean and variances






NUMBER OF SAMPLES =1000
120
100
80
60
40
20
0
1.6
1.8
2.0
2.2
2.4


NUMBER OF SAMPLES =10000
600
500
400
300
200
100
0
1.4
1.6
1.8
2.0
2.2
2.4

Geometric Distribution:

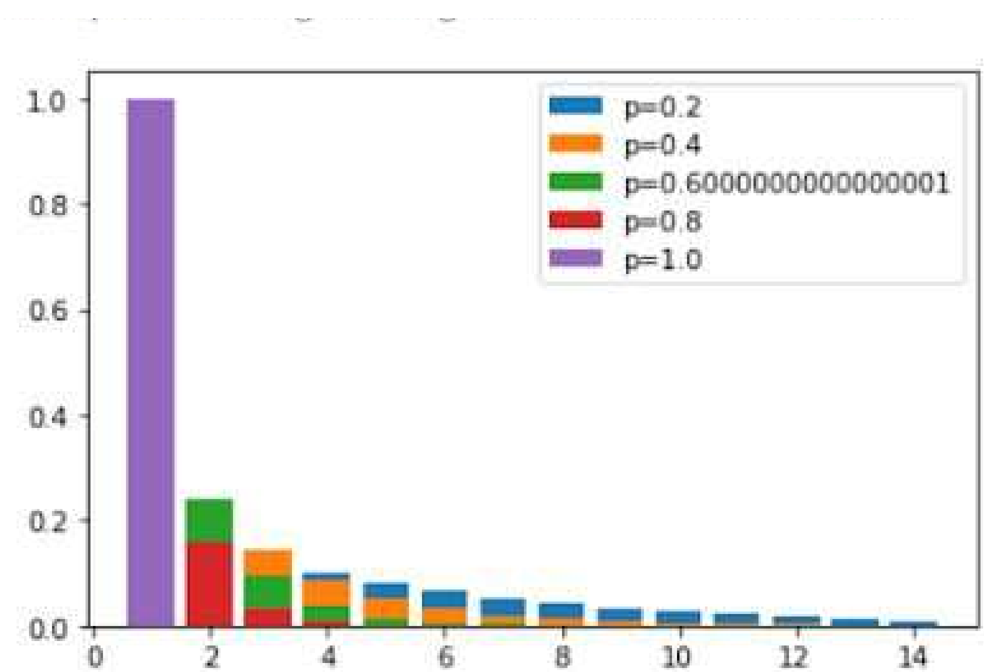
The geometric distribution represents the number of failures before you get a success in a series of Bernoulli trials.

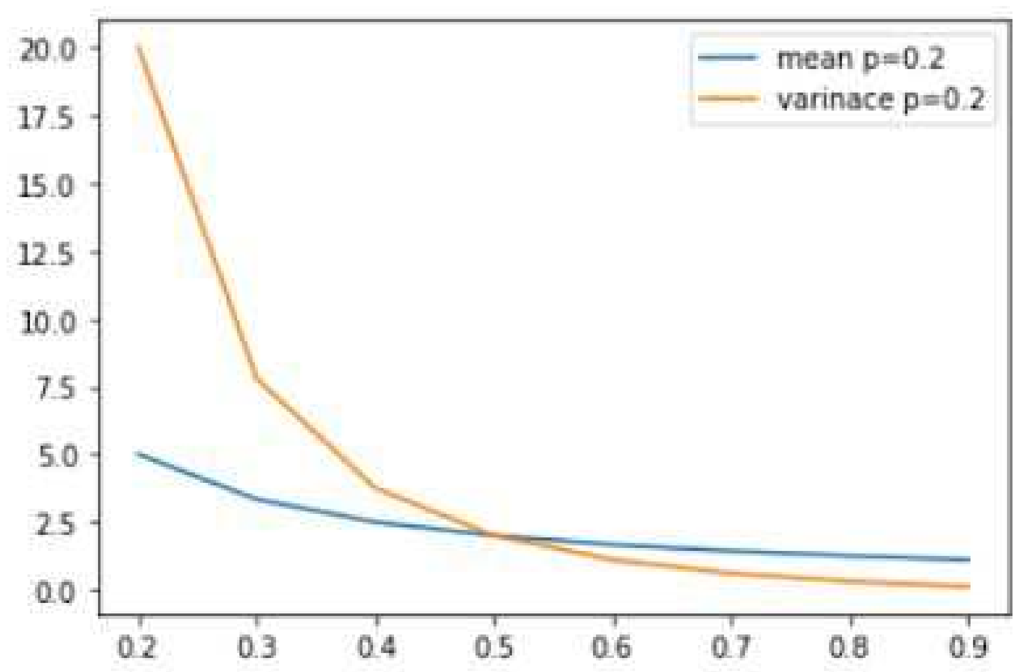
First part:
 p is the parameter

Using **Probability density function:** $f(x) = (1 - p)^{x - 1}p$

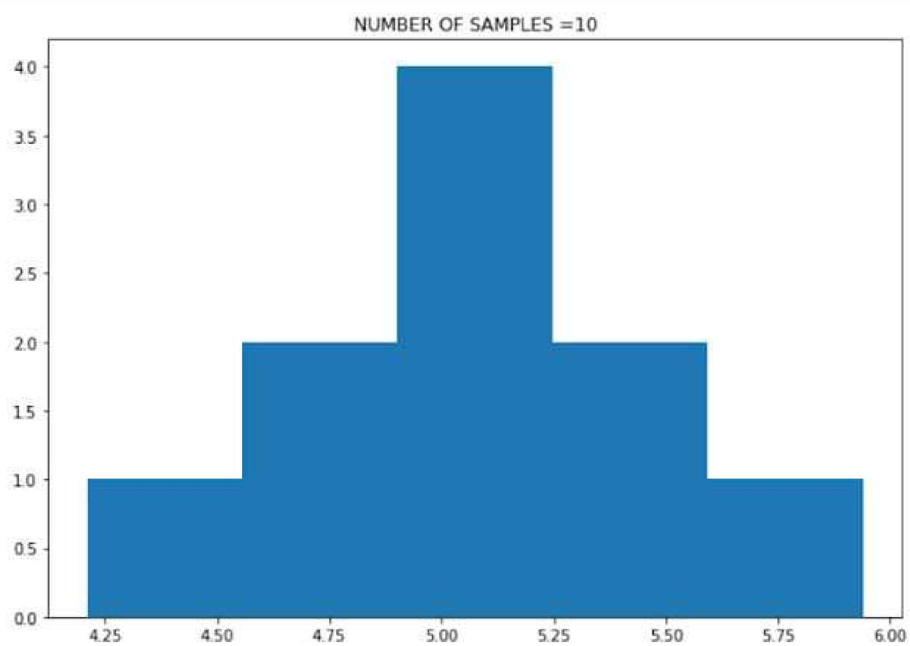
We plot the geometric distribution by changing the parameter p

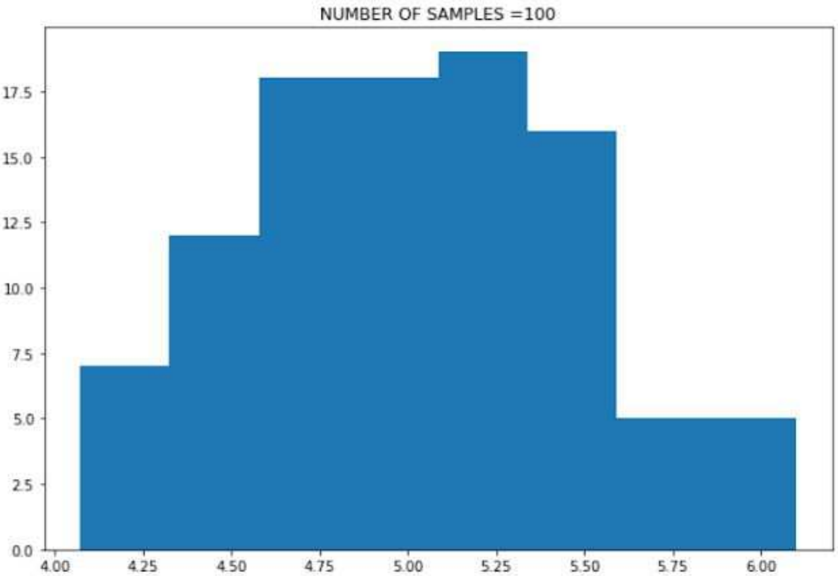
Using **mean= 1/p , variance=(1-p)/(p^2)**
We plot different graphs by changing mean and variance accordingly.

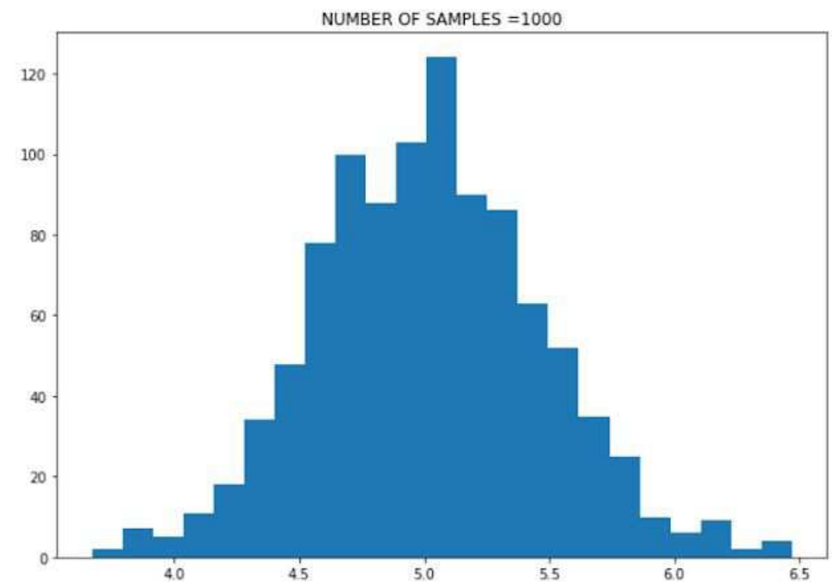


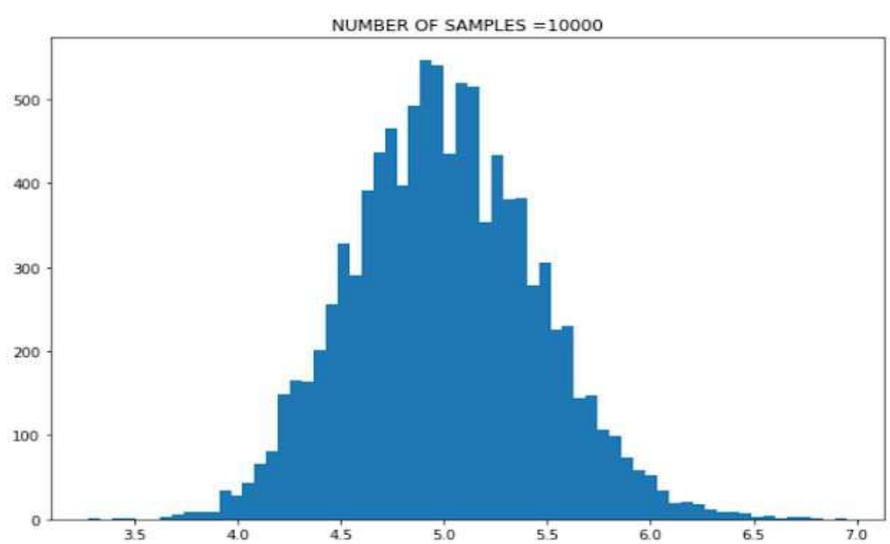


Second part:
Plotting graph for 40 samples using the function
np.random.geometric(p,size)
Plotted graphs for different values of p and calculated mean and variances




NUMBER OF SAMPLES =100
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
4.00
4.25
4.50
4.75
5.00
5.25
5.50
5.75
6.00


NUMBER OF SAMPLES =1000
120
100
80
60
40
20
0
4.0
4.5
5.0
5.5
6.0
6.5

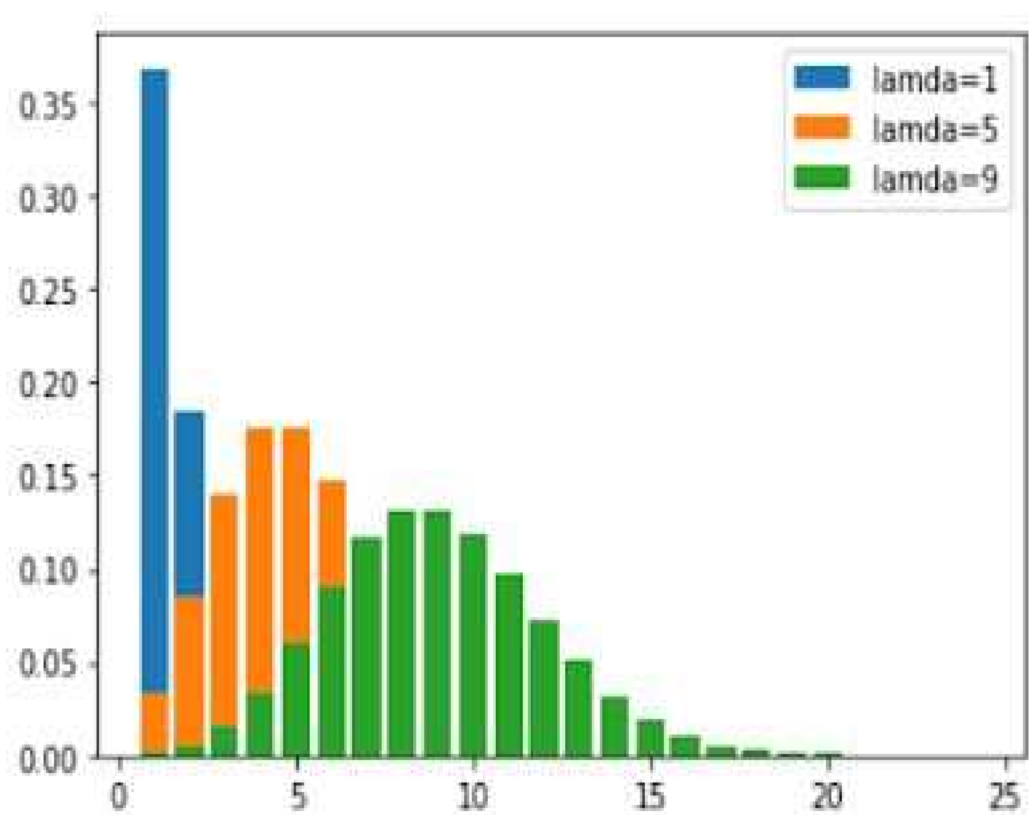

NUMBER OF SAMPLES =10000
500
400
300
200
100
0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0

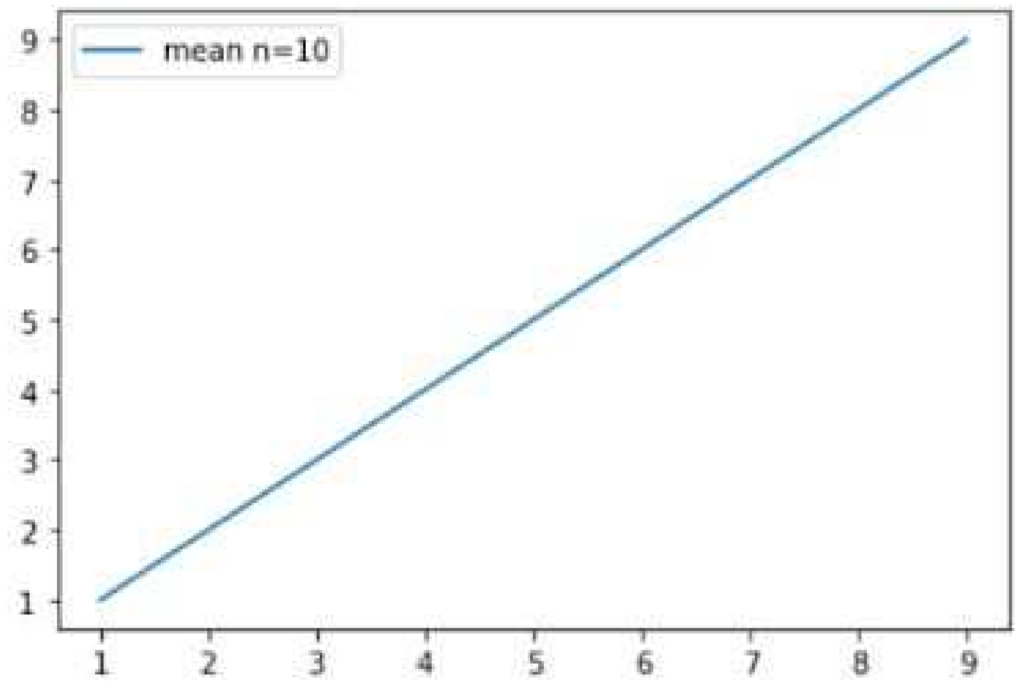
Poisson Distribution:

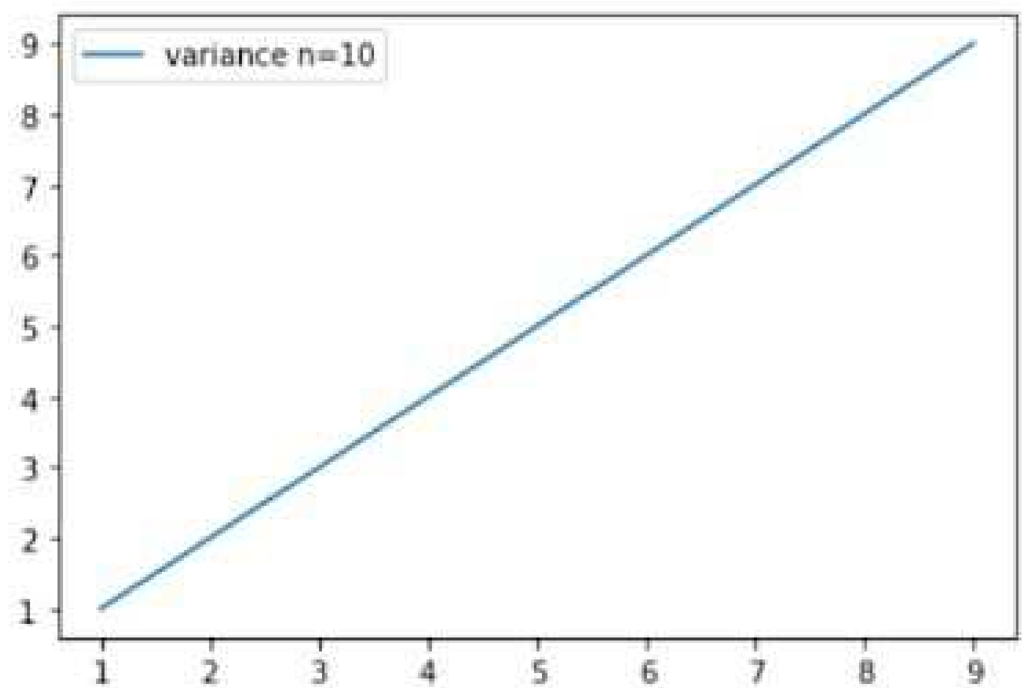
It is a statistical distribution that shows how many times an event is likely to occur within a specified period of time. It is used for independent events which occur at a constant rate within a given interval of time.

First part:
Lamda is the parameter
Using **Probability density function: f(x) =(lamda^x)* exp(-lamda)/x!**
We plot the poisson distribution by changing the parameter lamda

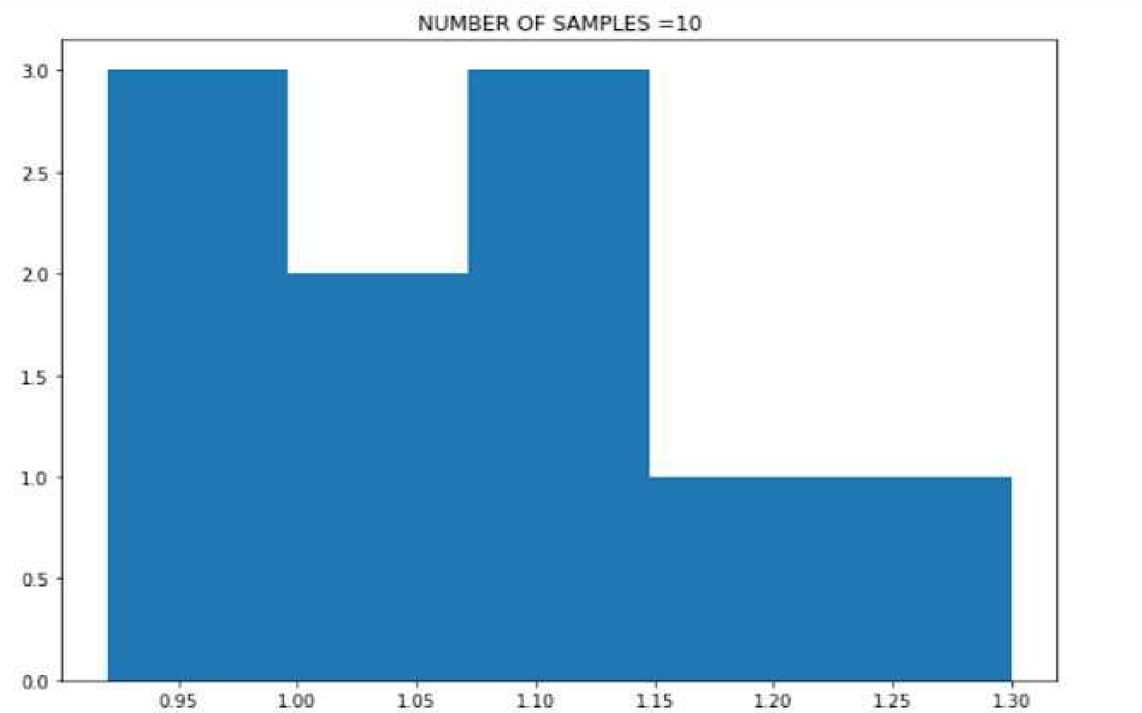
Using **mean= lamda , variance=lamda**
We plot different graphs by changing mean and variance accordingly.

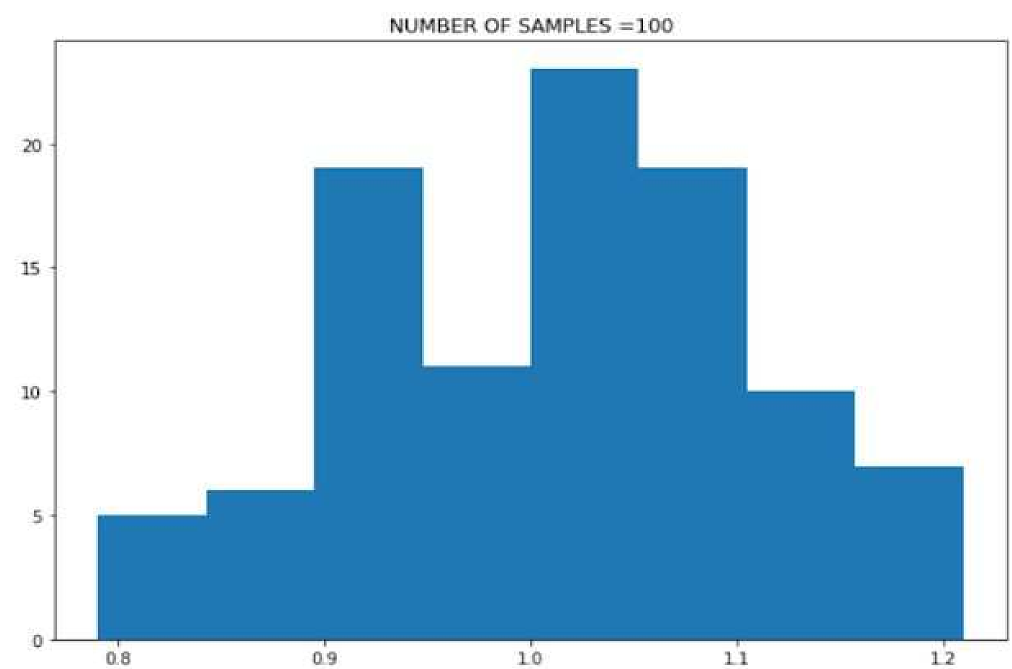


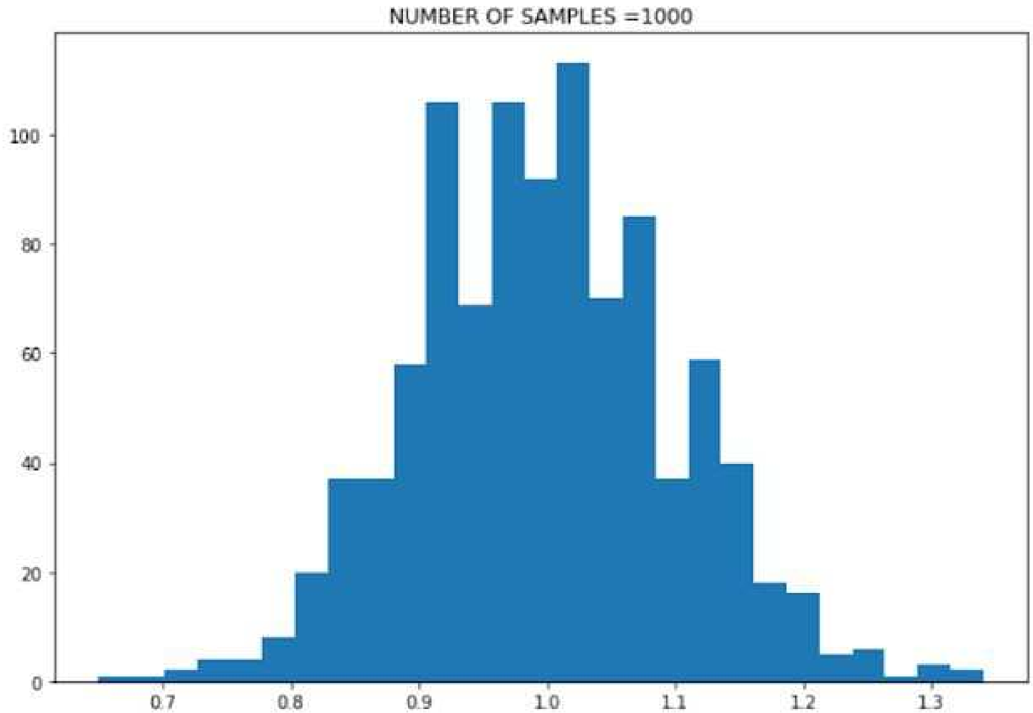

mean n=10
1
2
3
4
5
6
7
8
9

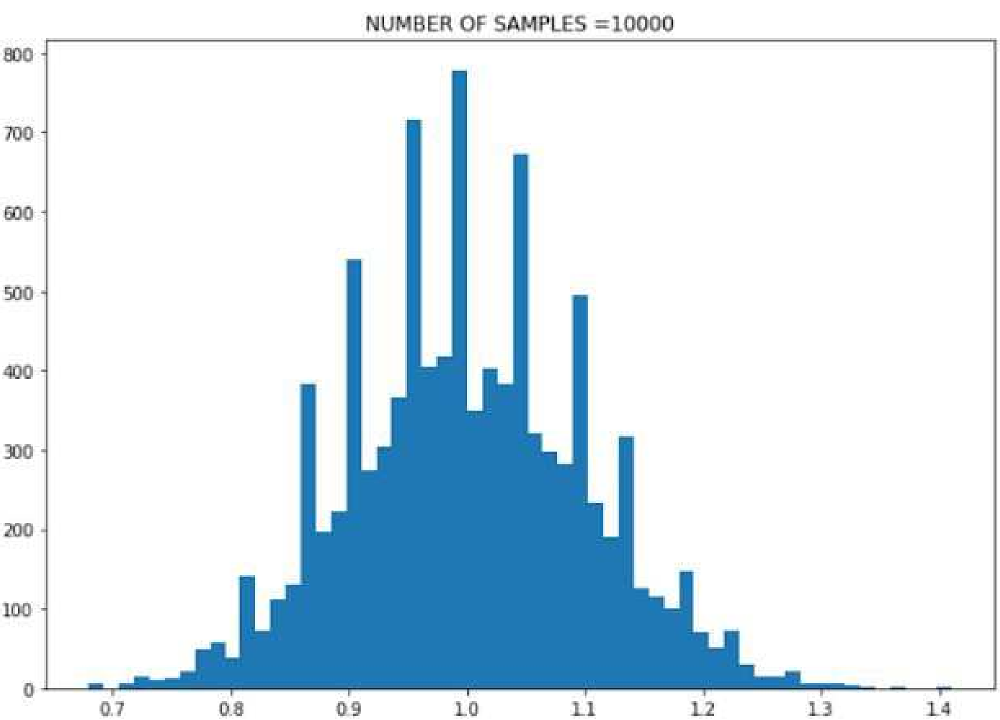

variance n=10
1
2
3
4
5
6
7
8
9

Second part:
Plotting graph for 40 samples
using the function **np.random.poisson(1,n)**
Plotted graphs for different values of lamda and calculated mean and variances






NUMBER OF SAMPLES =1000
0
20
40
60
80
100
0.7
0.8
0.9
1.0
1.1
1.2
1.3

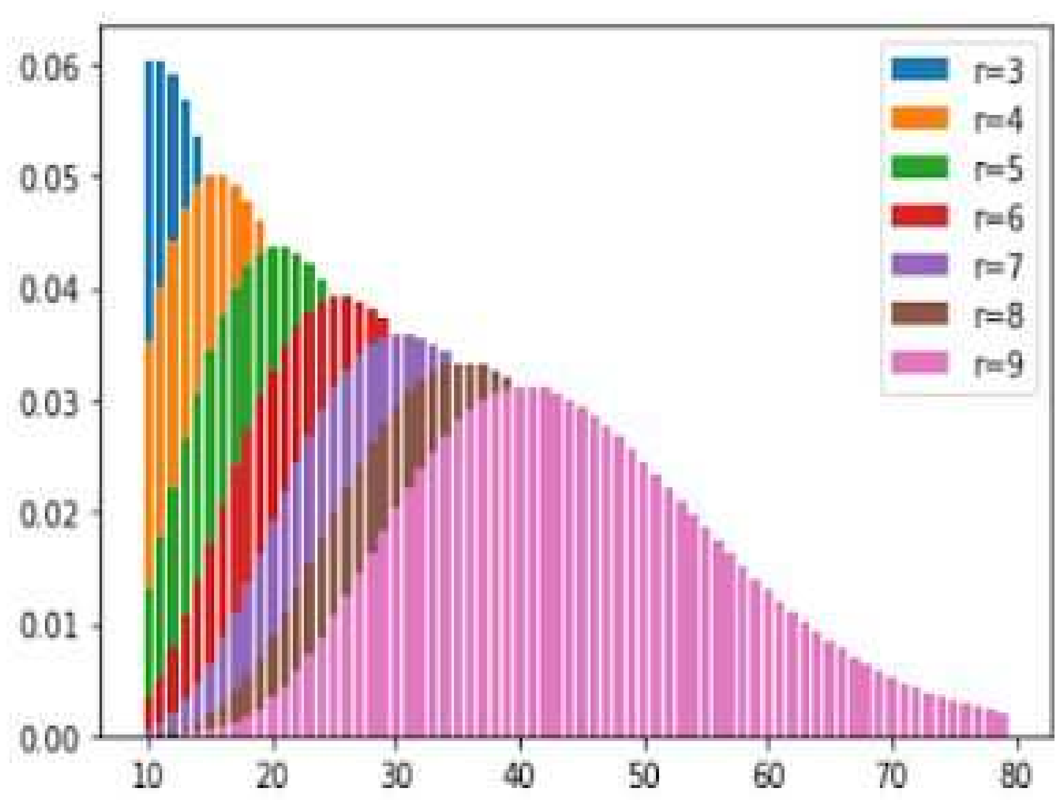

NUMBER OF SAMPLES =10000
0
100
200
300
400
500
600
700
800
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4

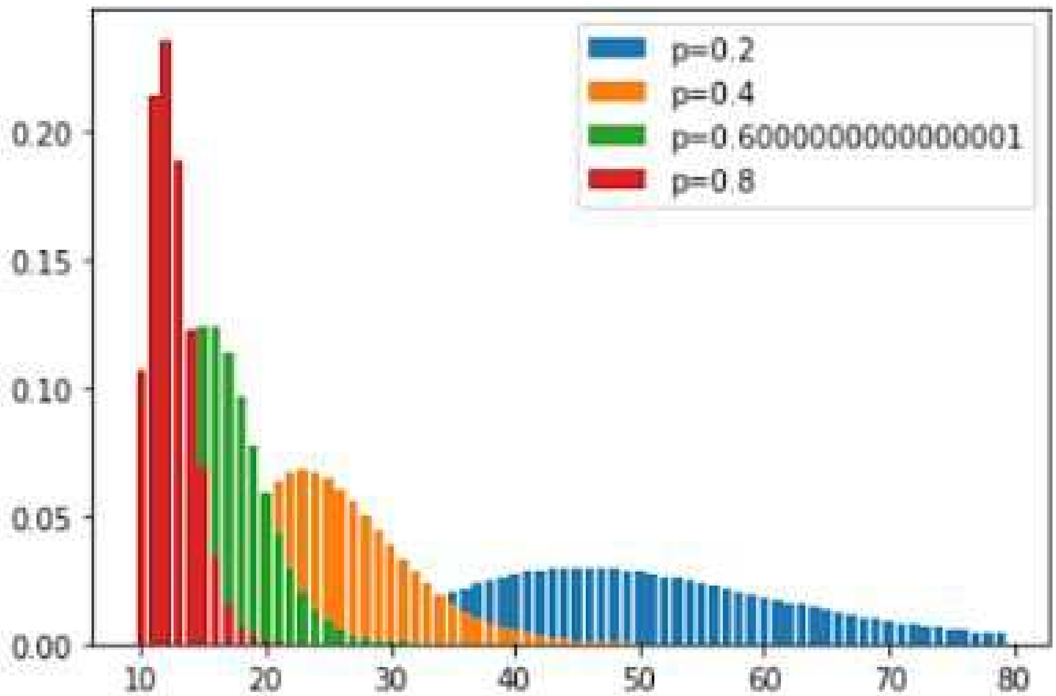
Negative Binomial Distribution:

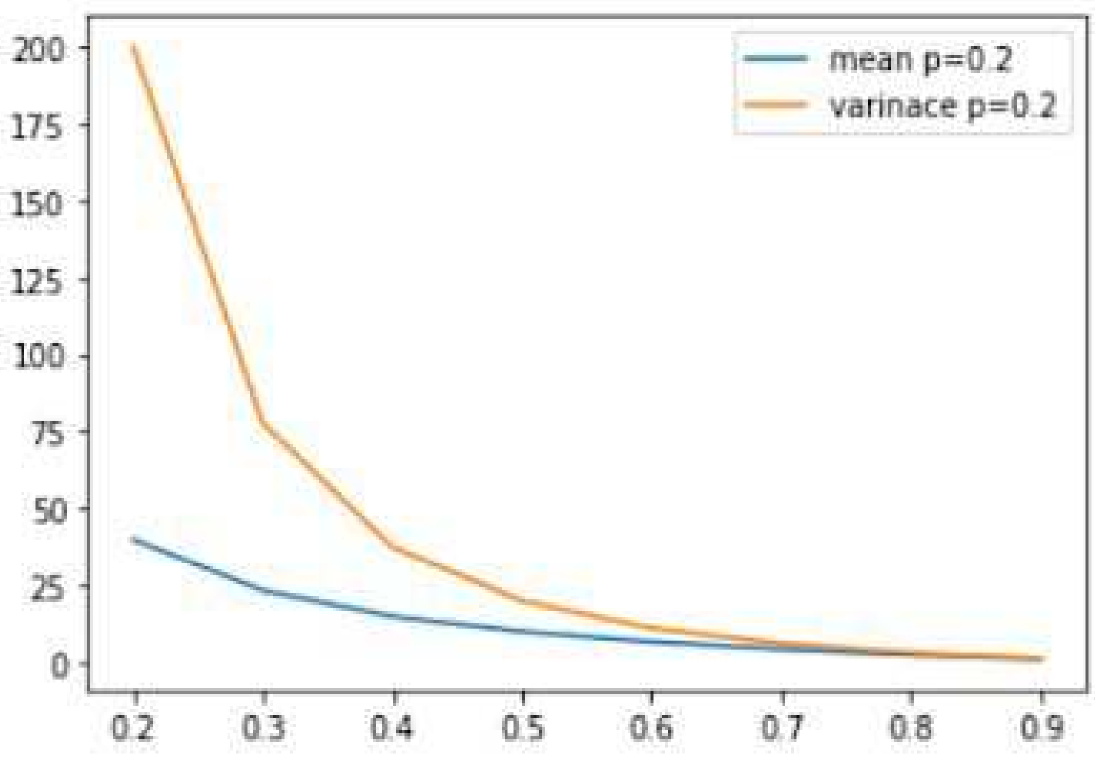
Distribution with the number of trials X that must occur until we have r successes. The number r is a whole number that we choose before we start performing our trials.

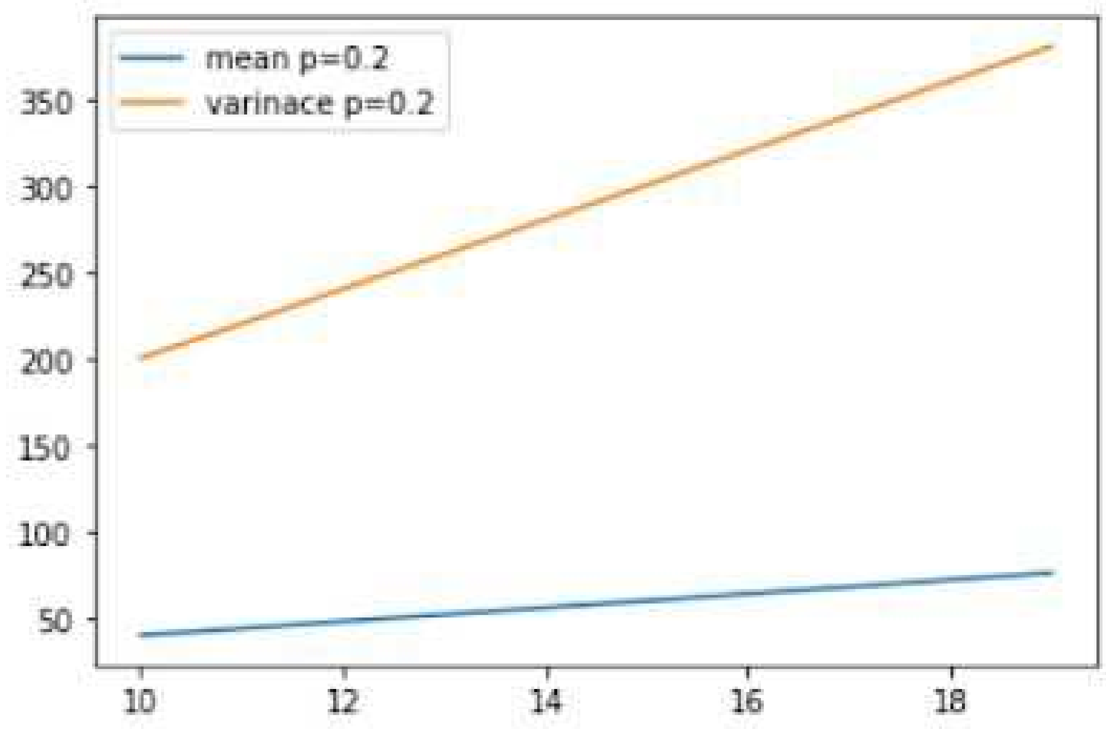
First part:
r,p are the parameters
Using **Probability density function: f(x) =(k-1)!/(k-r)!*(r-1)!**
We plot the negative binomial distribution by changing the parameter r, p

Using **mean= r*(1-p)/p , variance=r*(1-p)/(p^2)**
We plot different graphs by changing mean and variance accordingly.

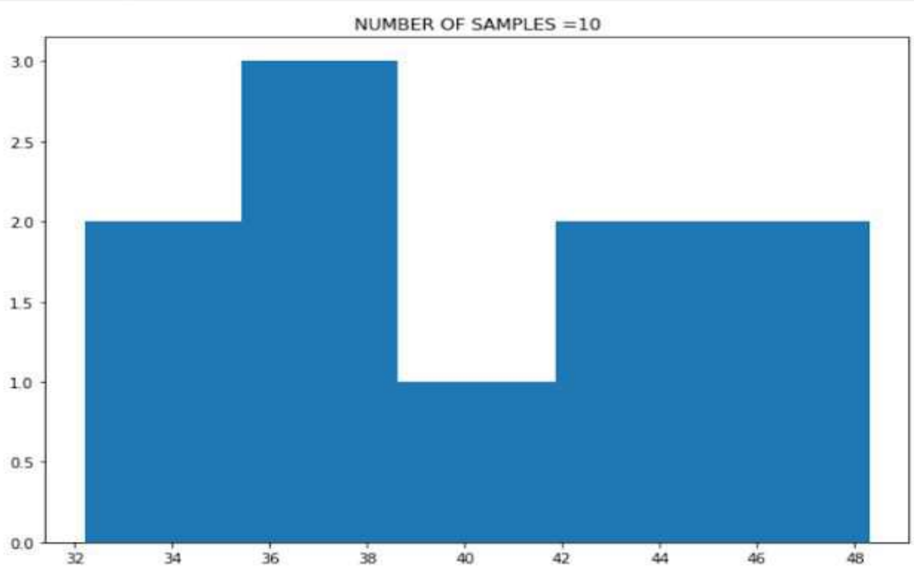


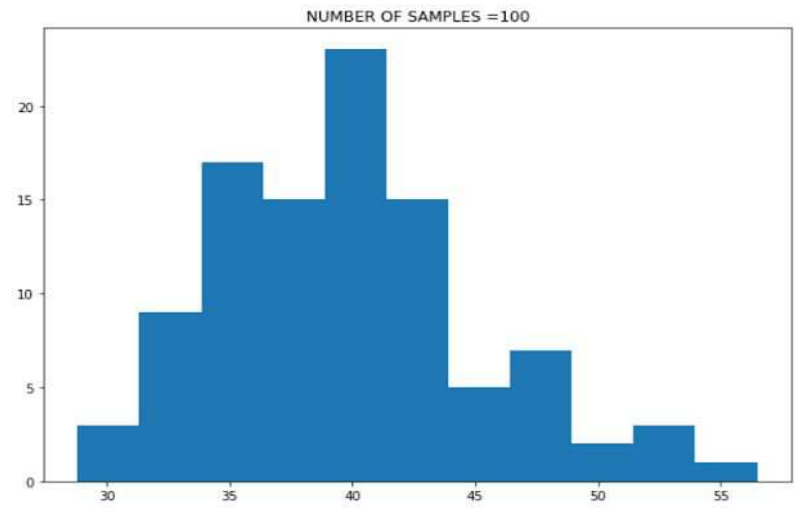

p=0.2
p=0.4
p=0.6000000000000001
p=0.8
0.20
0.15
0.10
0.05
0.00
10
20
30
40
50
60
70
80

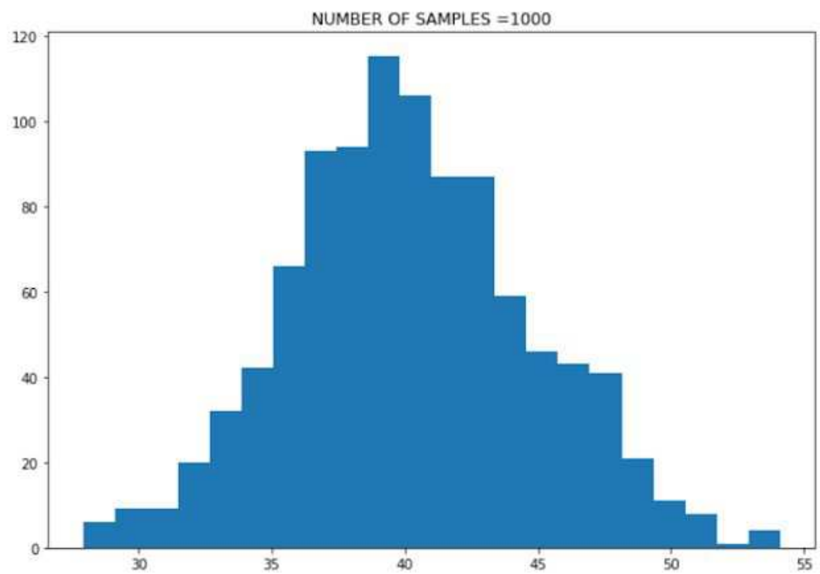

mean p=0.2
varinace p=0.2
200
175
150
125
100
75
50
25
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

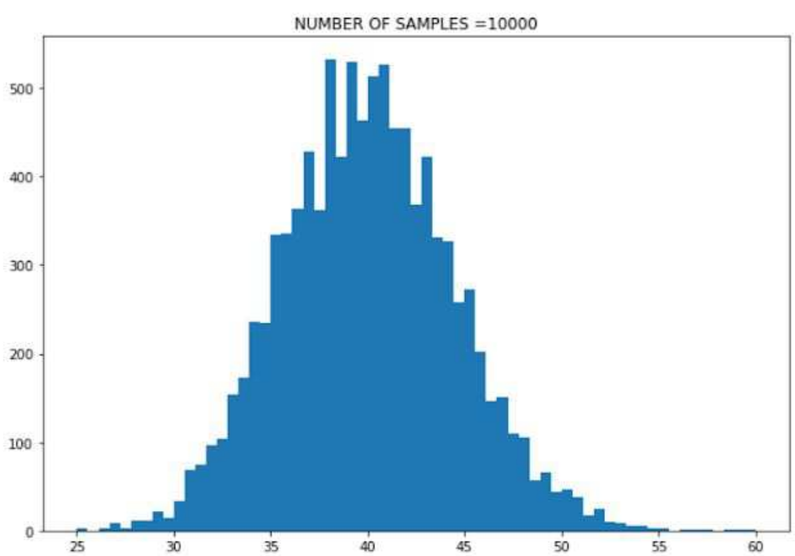


Second part:
Plotting graph for 40 samples
using the function **np.random.negative_binomial(n,p,size)**
Plotted graphs for different values of n and p and calculated mean and variances




NUMBER OF SAMPLES =100
0
5
10
15
20
30
35
40
45
50
55


NUMBER OF SAMPLES =1000
0
20
40
60
80
100
120
30
35
40
45
50
55

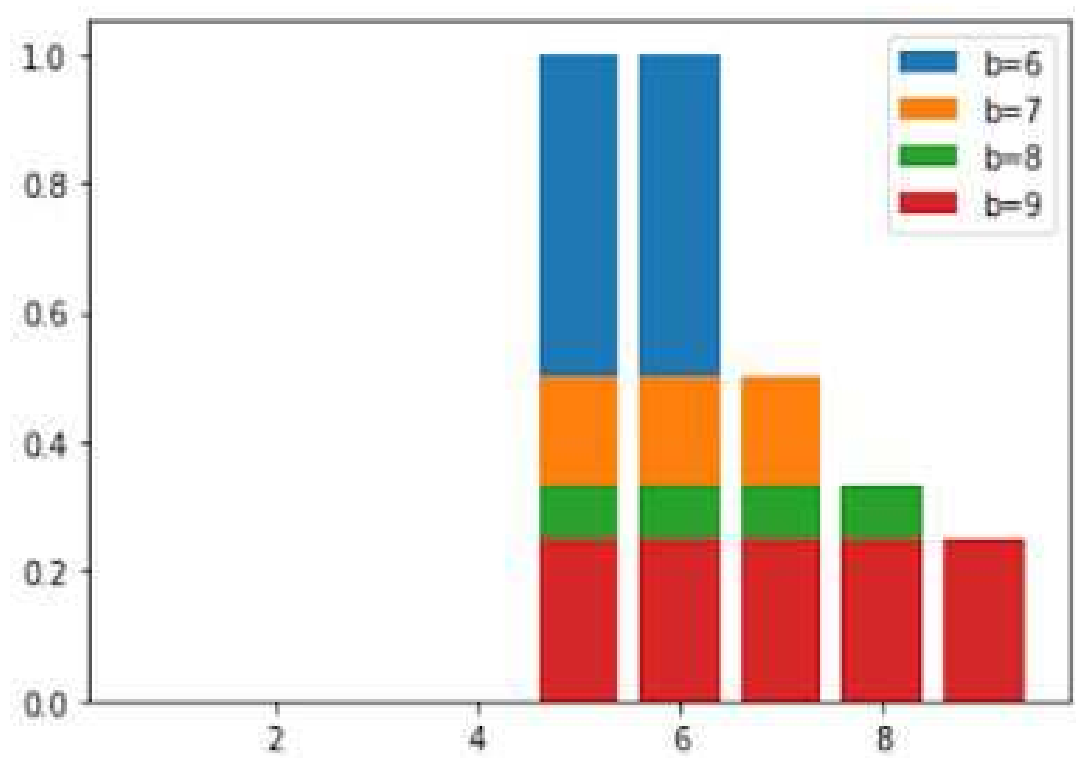

NUMBER OF SAMPLES =10000
0
100
200
300
400
500
25
30
35
40
45
50
55
60

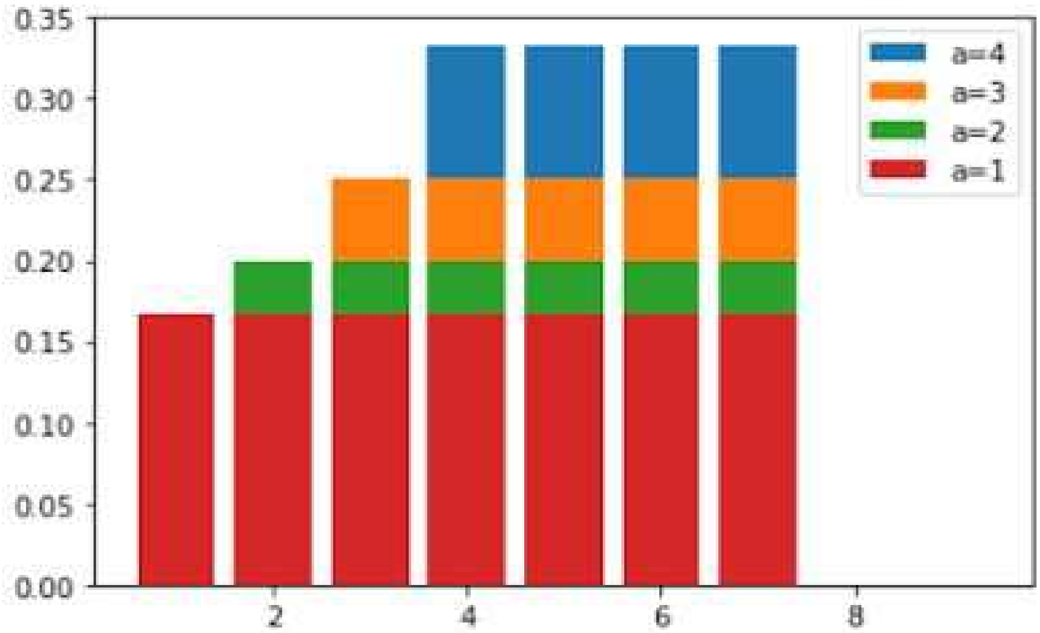
Discrete uniform Distribution:

It is a symmetric probability distribution wherein a finite number of values are equally likely to be observed

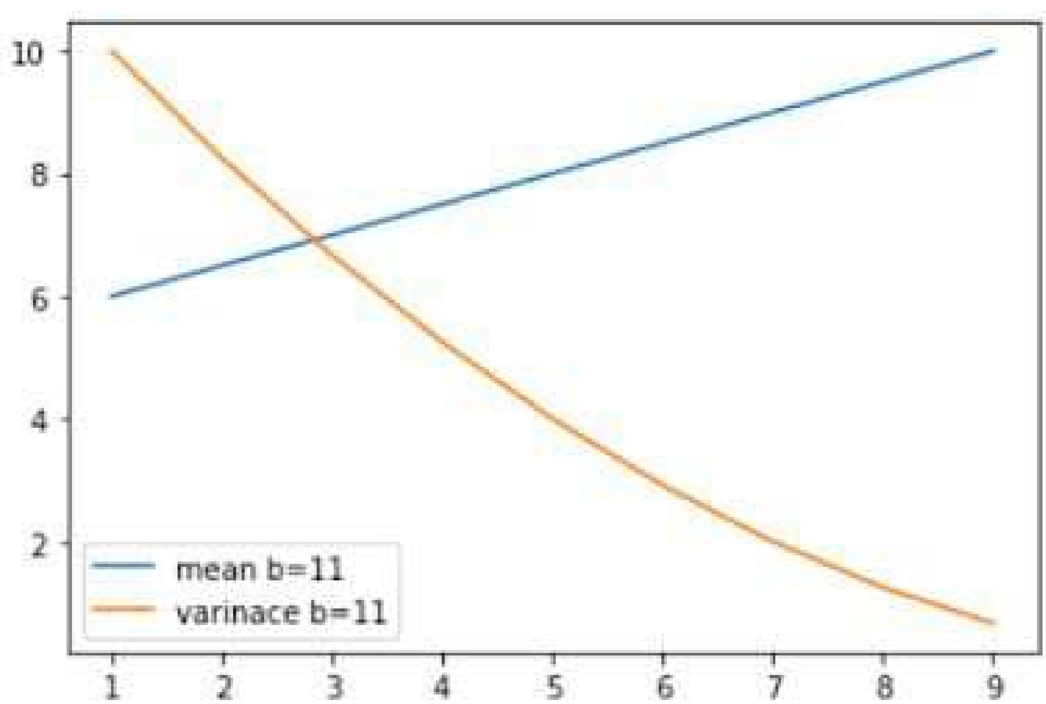
First part:
a,b are the parameters
Using **Probability density function: f(x) =1/(b-a) for a<x<b**
We plot the discrete uniform distribution by changing the parameter a,b

Using **mean= (a+b)/2 , variance=((b-a+1)^2-1)/12**
We plot different graphs by changing mean and variance accordingly.

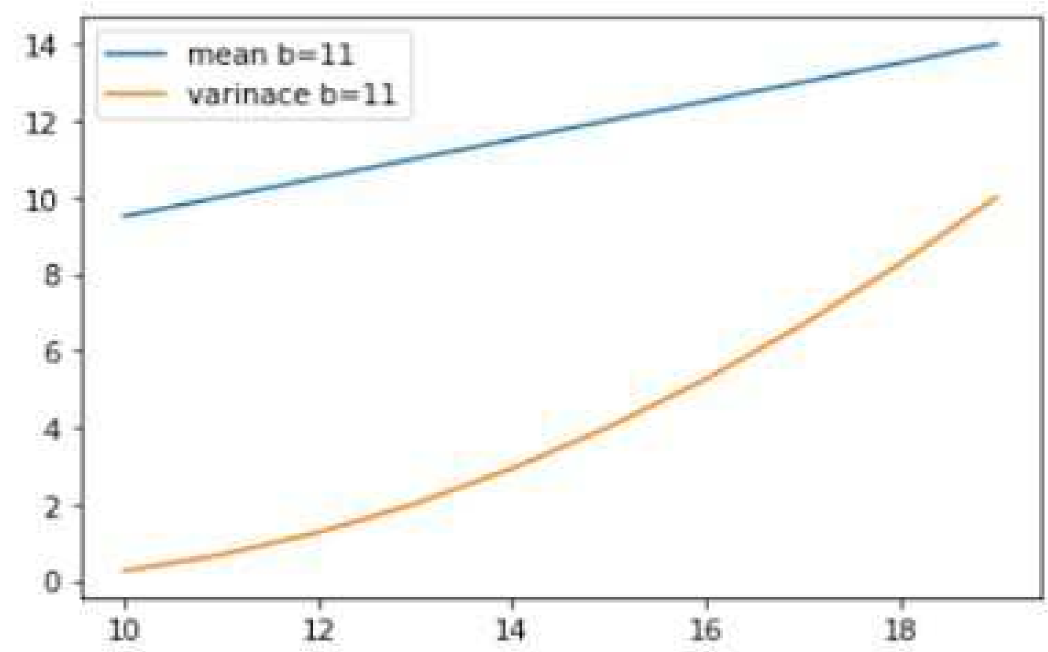




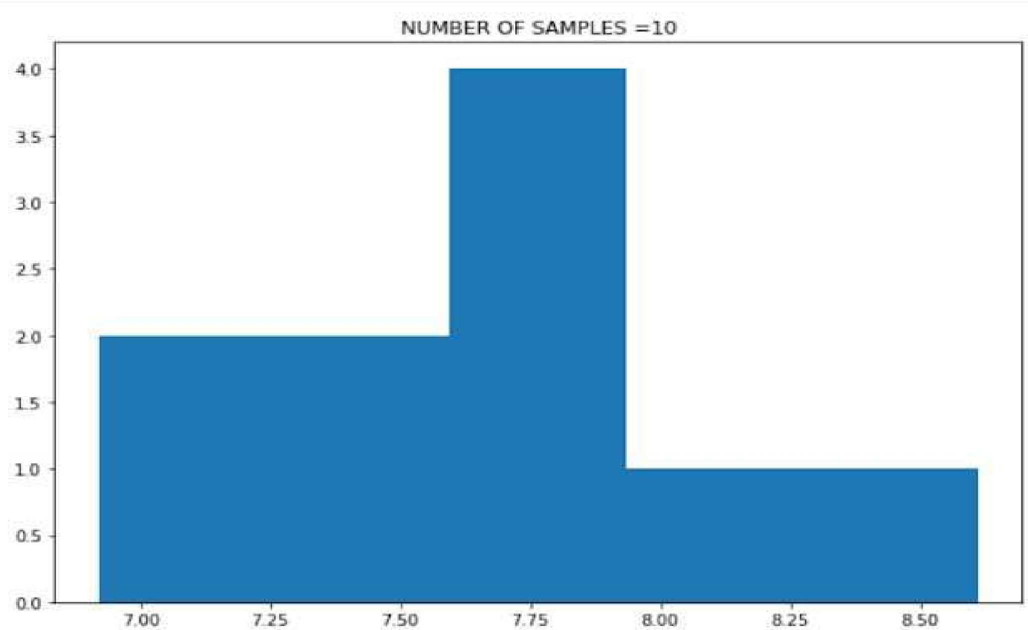
a=4
a=3
a=2
a=1

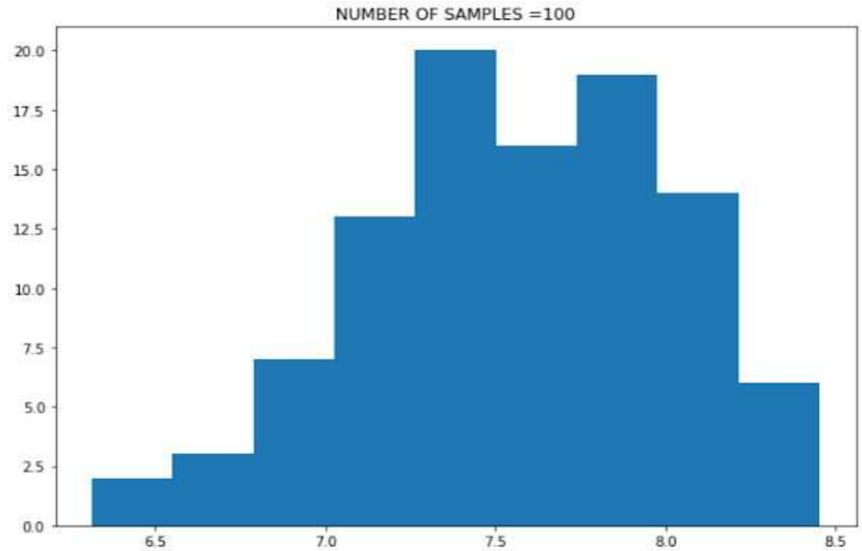


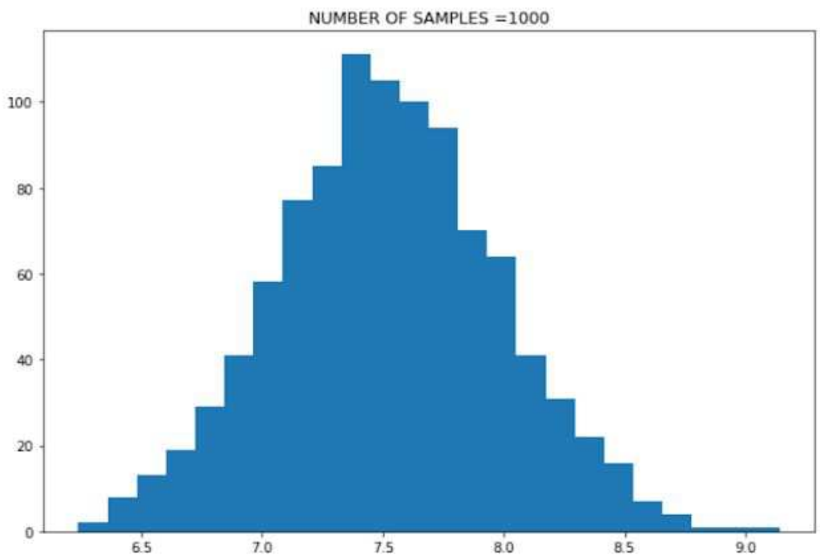
mean b=11
varinace b=11

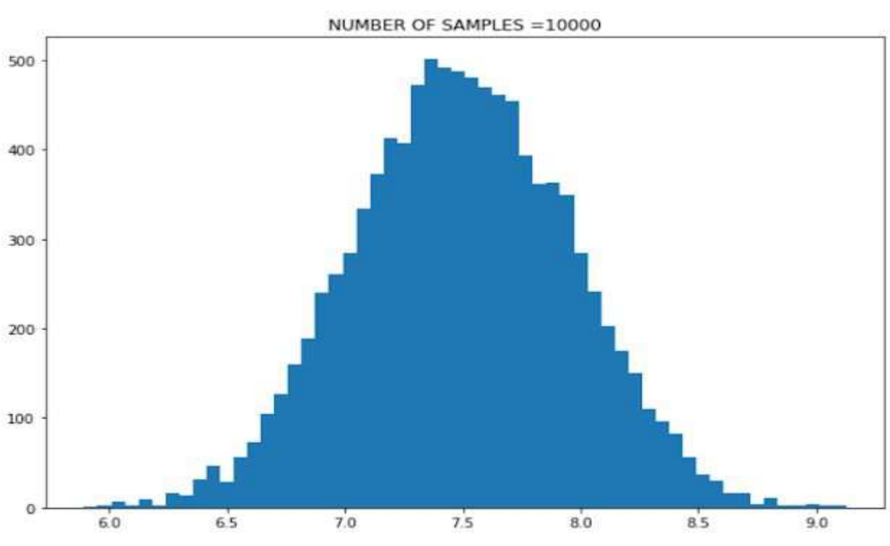


Second part:
Plotting graph for 40 samples
using the function **np.random.uniform(a,b,size)**
Plotted graphs for different values of a and b and calculated mean and variances




NUMBER OF SAMPLES =100
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
6.5
7.0
7.5
8.0
8.5


NUMBER OF SAMPLES =1000
100
80
60
40
20
0
6.5
7.0
7.5
8.0
8.5
9.0


NUMBER OF SAMPLES =10000
500
400
300
200
100
0
6.0
6.5
7.0
7.5
8.0
8.5
9.0

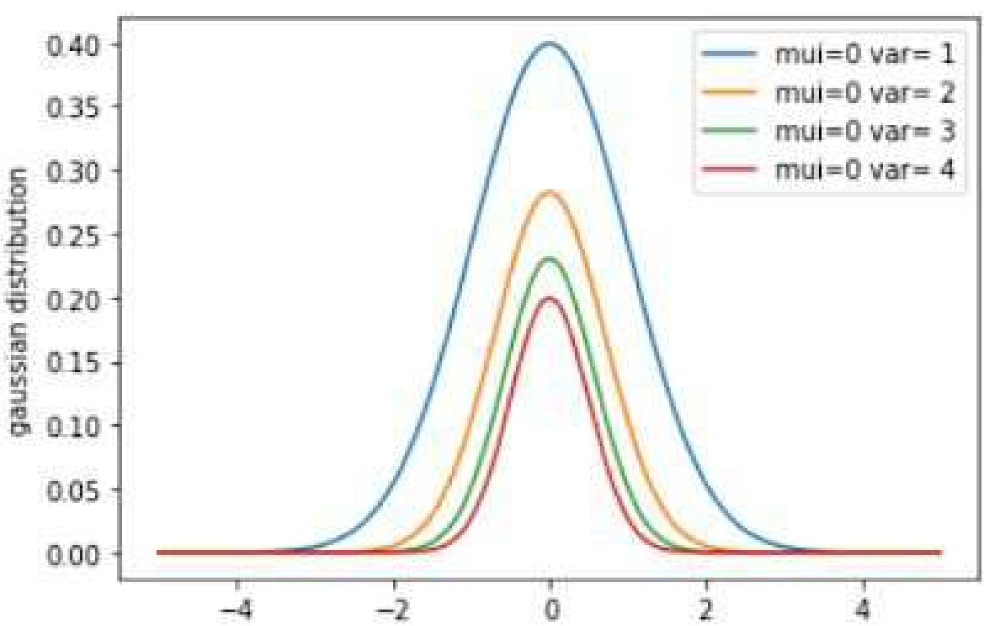
CONTINUOUS DISTRIBUTIONS

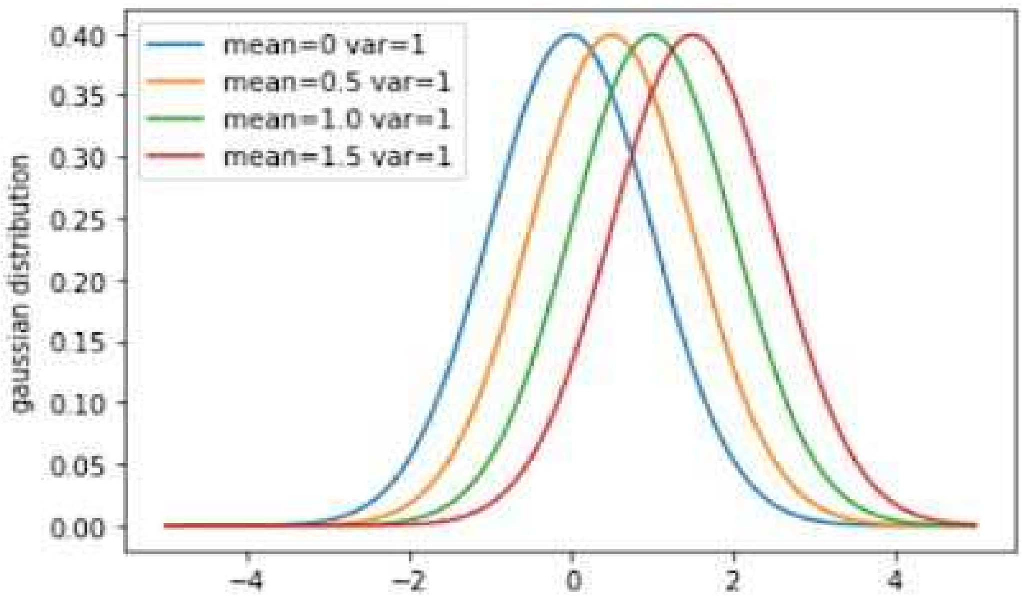
Normal Distribution:

It is symmetrical on both sides of the mean, so the right side of the center is a mirror image of the left side. The area under the normal distribution curve represents probability and the total area under the curve sums to one.

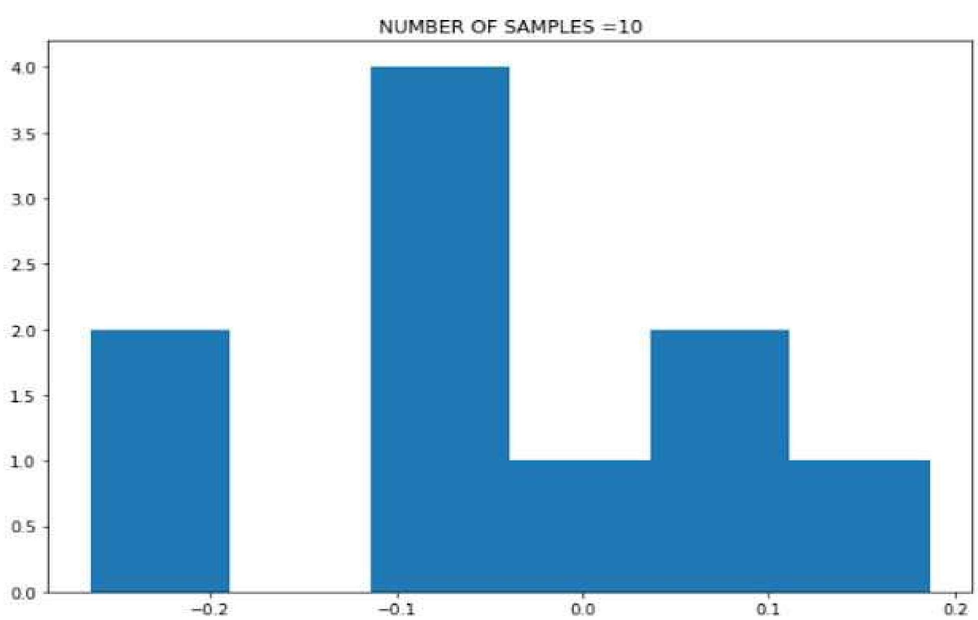
First part:
Mean, variance are the parameters
Using **Probability density function:**
f(x) =exp(-½ * (x-u/sigma)^2)/ sigma*sqrt(2*pi)
We plot the normal distribution by changing the parameter mean, variance

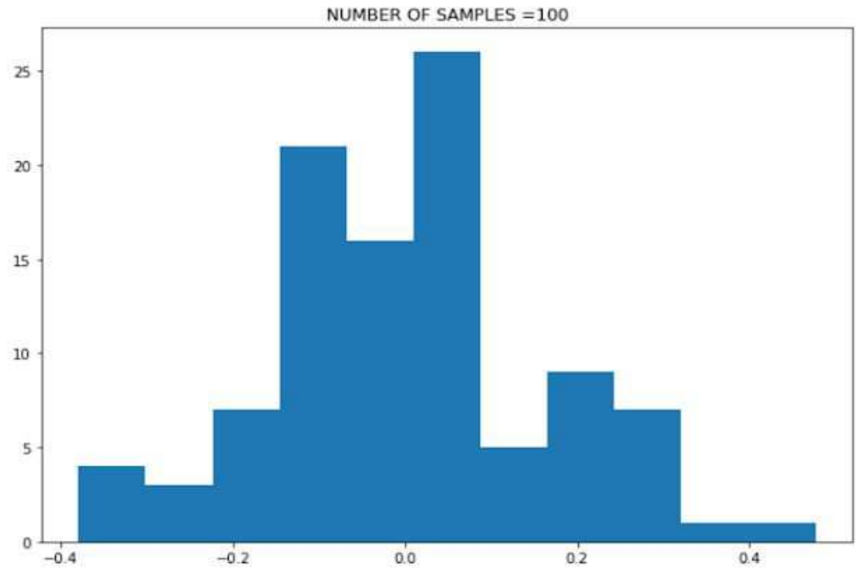
Using **mean= u , variance=sigma^2**
We plot different graphs by changing mean and variance accordingly.

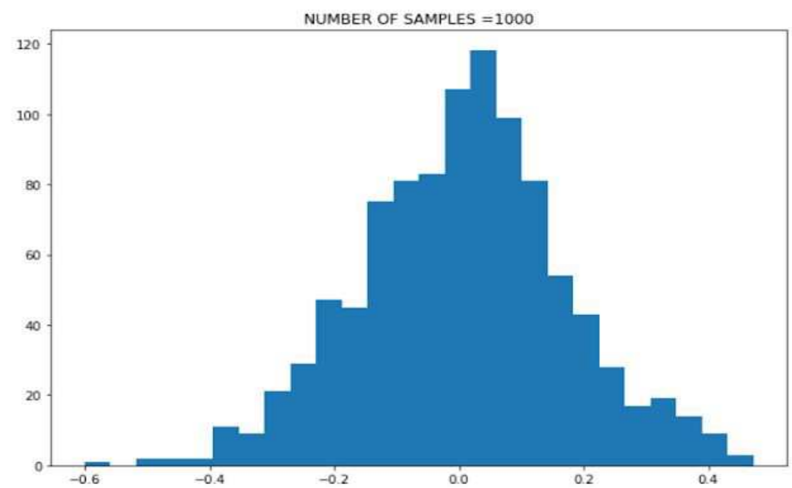


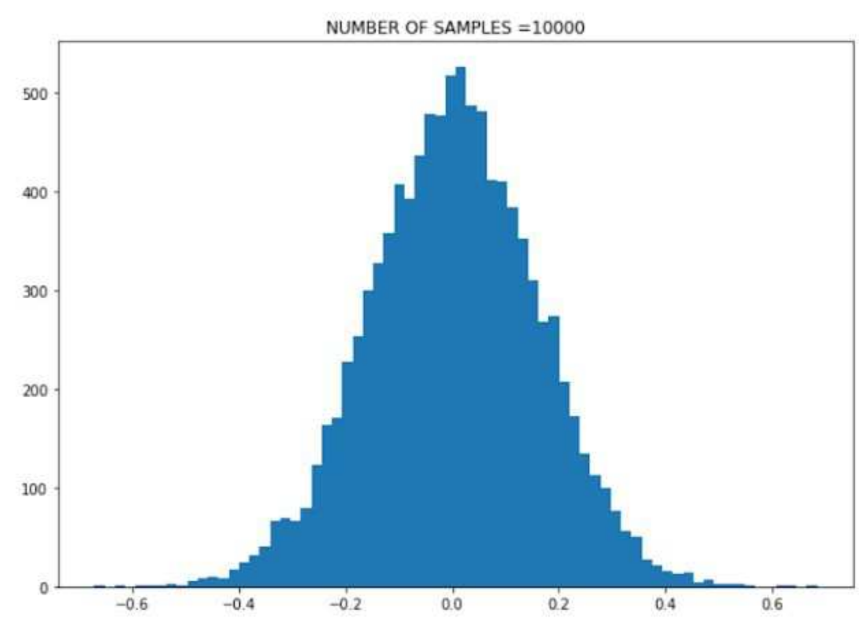


Second part:
Plotting graph for 40 samples
using the function **np.random.normal(mean,variance,size)**
Plotted graphs for different values of n and p and calculated mean and variances




NUMBER OF SAMPLES =100


NUMBER OF SAMPLES =1000

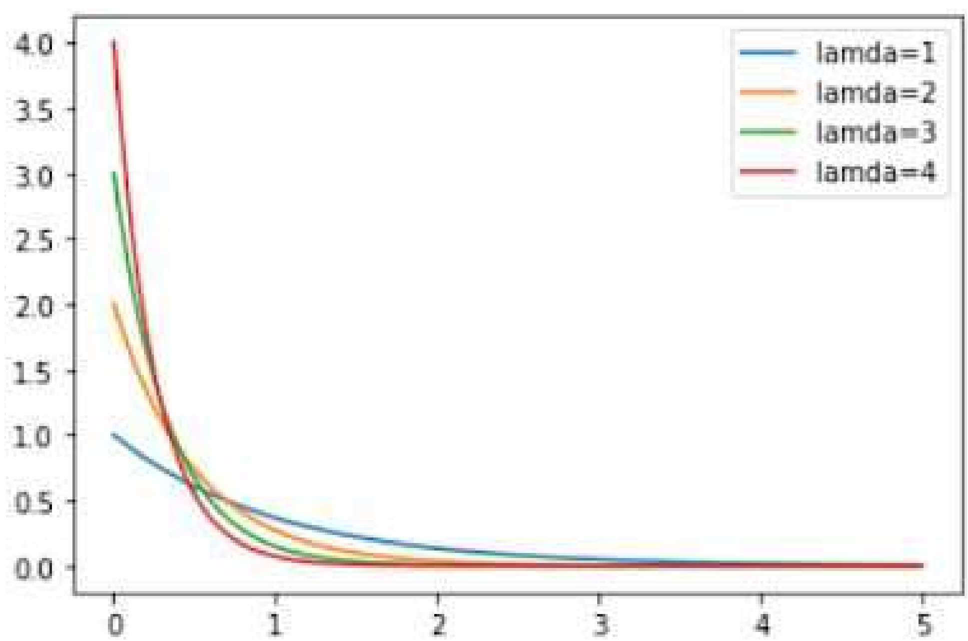

NUMBER OF SAMPLES =10000

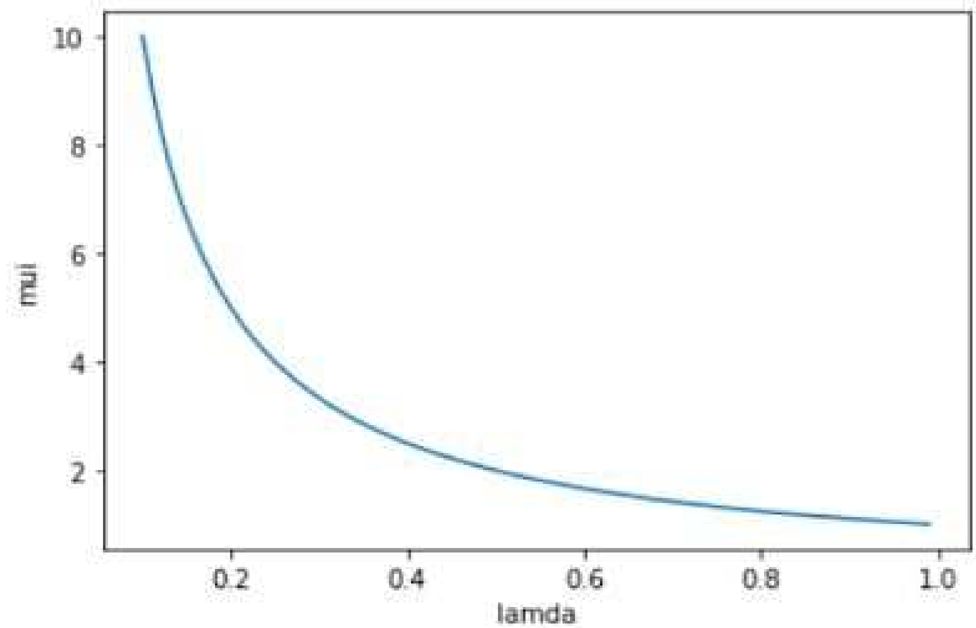
Exponential Distribution:

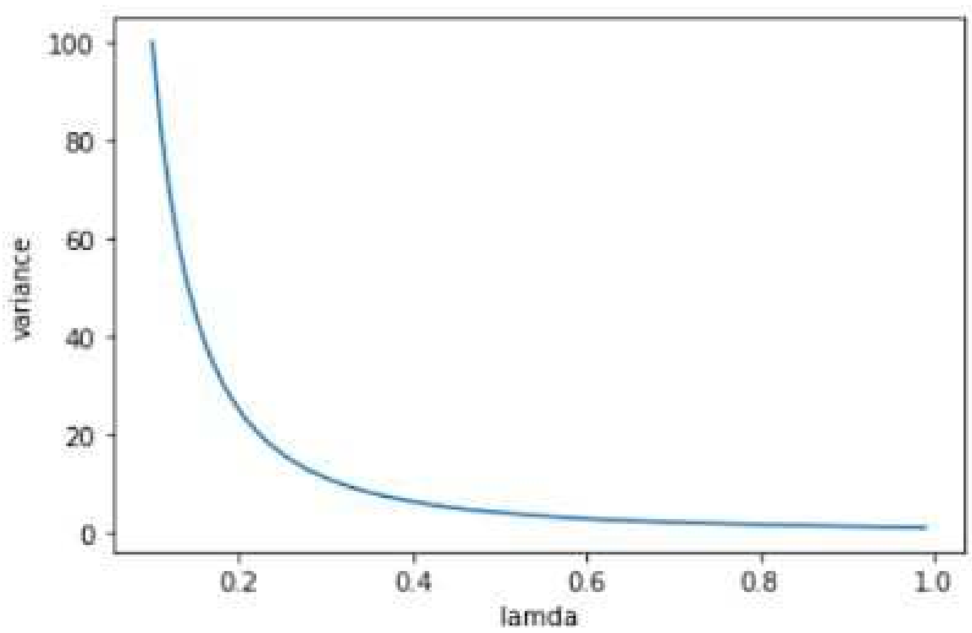
A process in which events occur continuously and independently at a constant average rate

First part:
lamda is the parameter
Using **Probability density function:**
f(x) =lamda* exp(-lamda*x)
We plot the exponential distribution by changing the parameter lamda

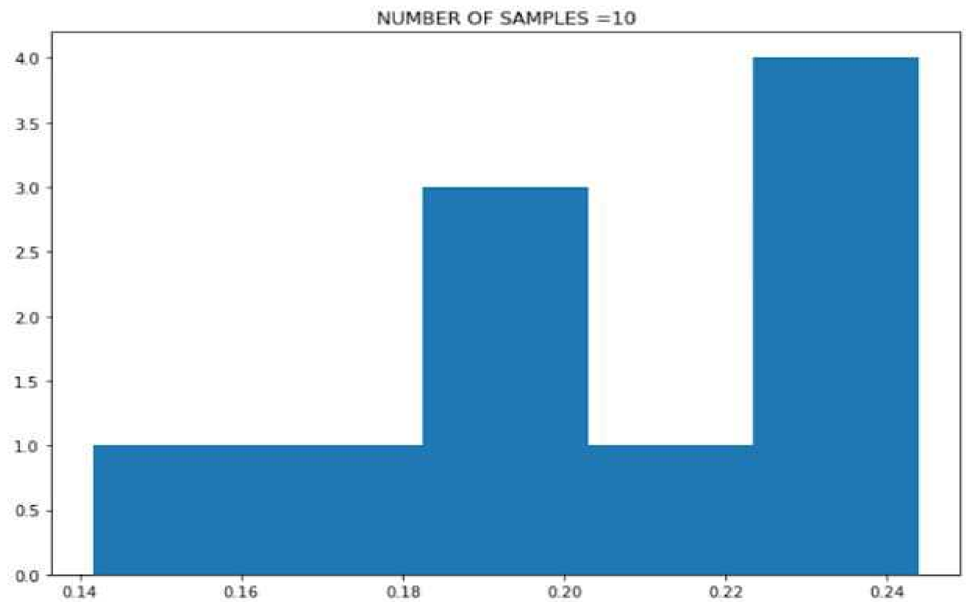
Using **mean= 1/lamda , variance=1/lamda^2**
We plot different graphs by changing mean and variance accordingly.

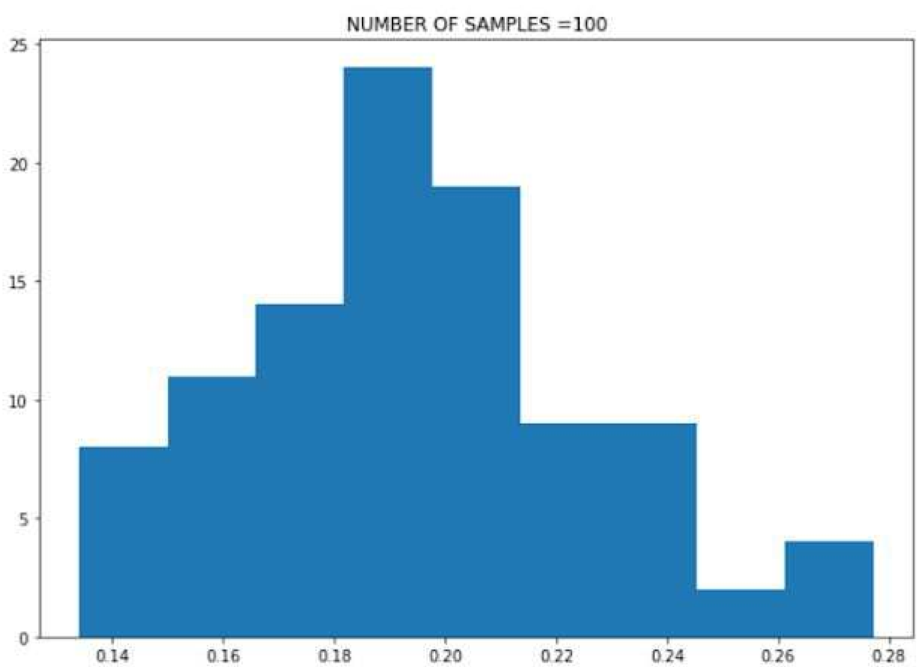


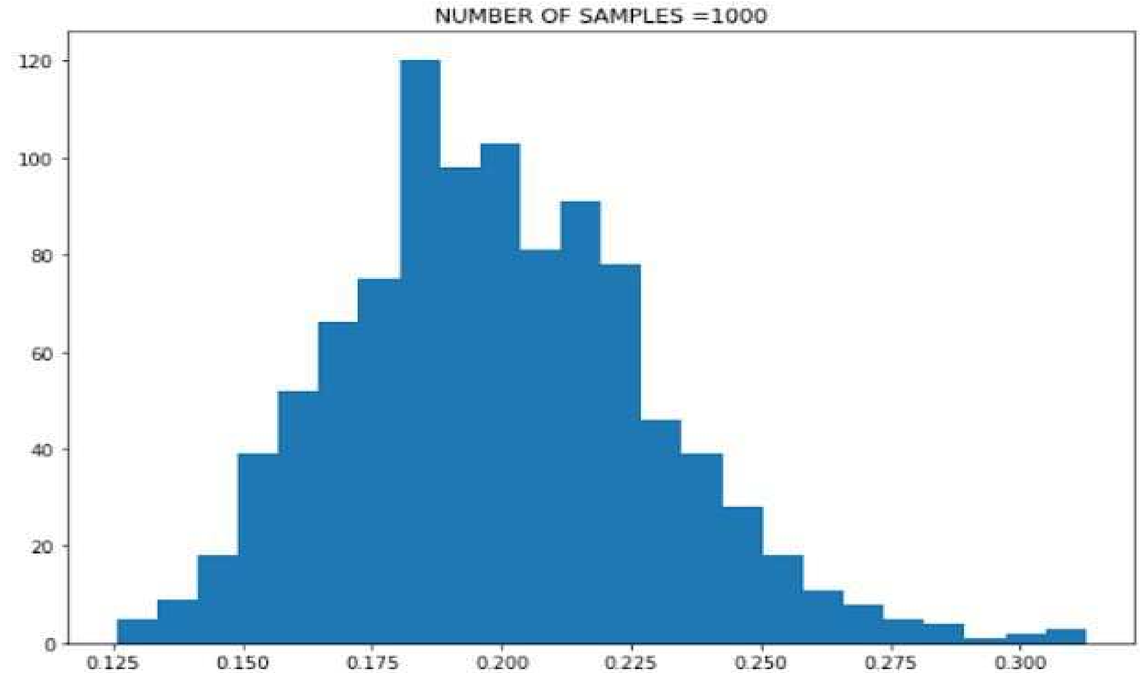

10
8
6
4
2
mui
0.2
0.4
0.6
0.8
1.0
lamda

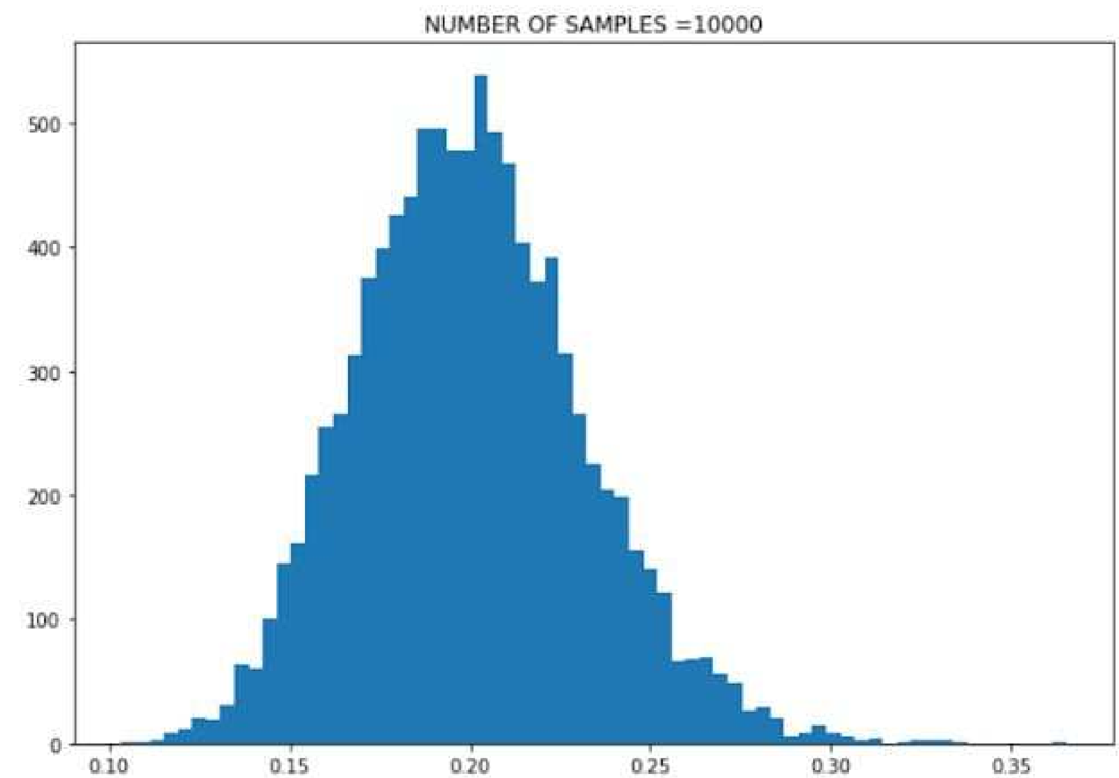

100
80
60
40
20
0
variance
0.2
0.4
0.6
0.8
1.0
lamda

Second part:
Plotting graph for 40 samples
using the function **np.random.exponential(mean,variance,size)**
Plotted graphs for different values of lamda and calculated mean and variances






NUMBER OF SAMPLES =1000
0
20
40
60
80
100
120
0.125
0.150
0.175
0.200
0.225
0.250
0.275
0.300

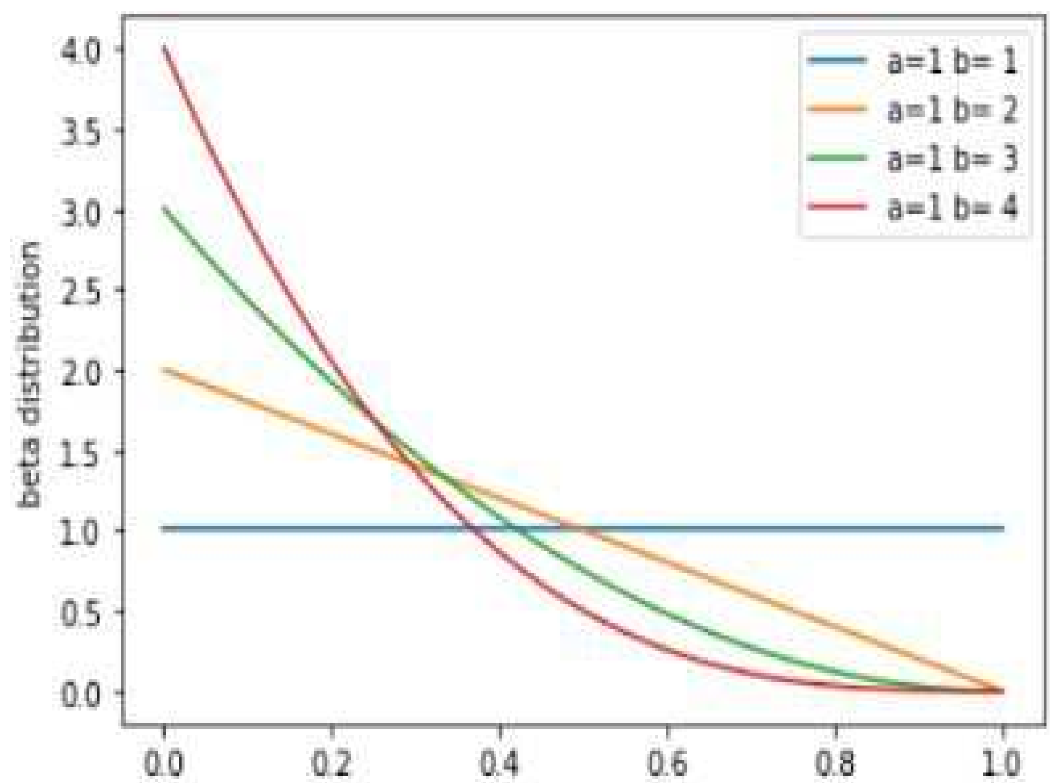

NUMBER OF SAMPLES =10000
0
100
200
300
400
500
0.10
0.15
0.20
0.25
0.30
0.35

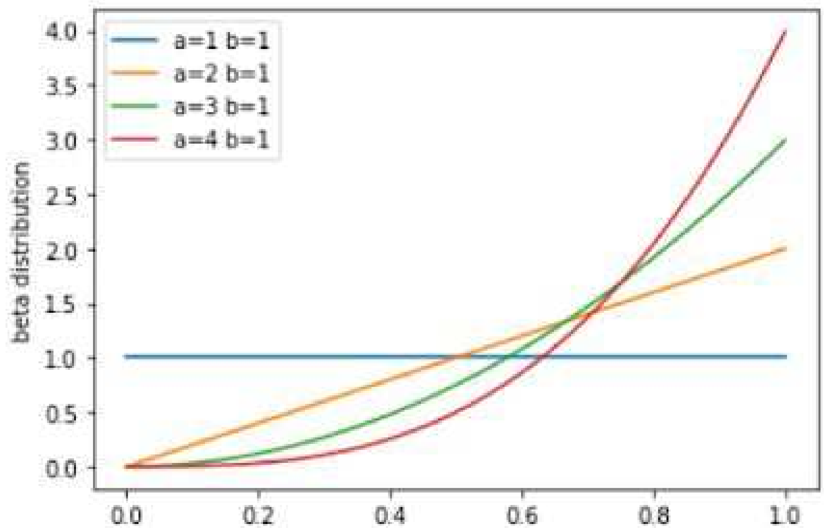
Beta Distribution:

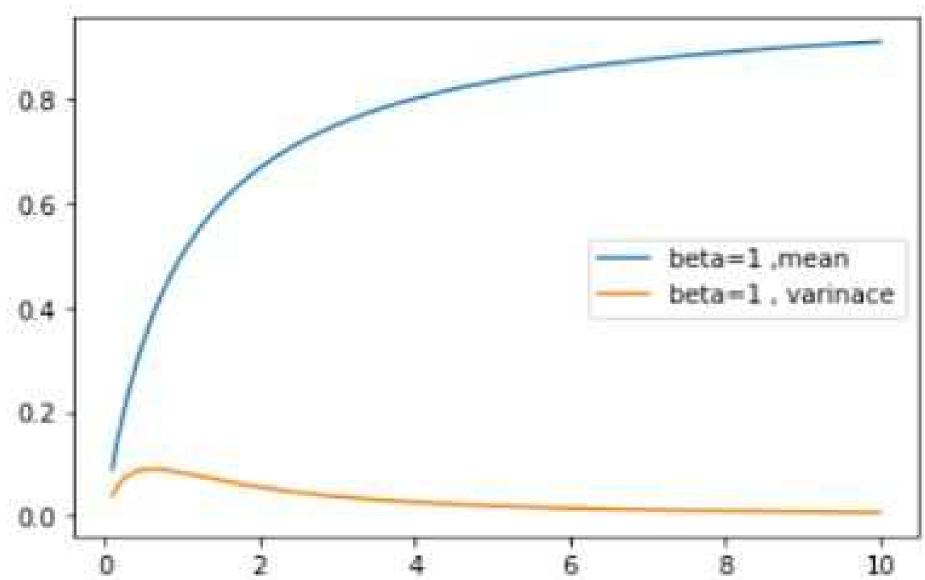
That can be used to represent proportion or probability outcomes

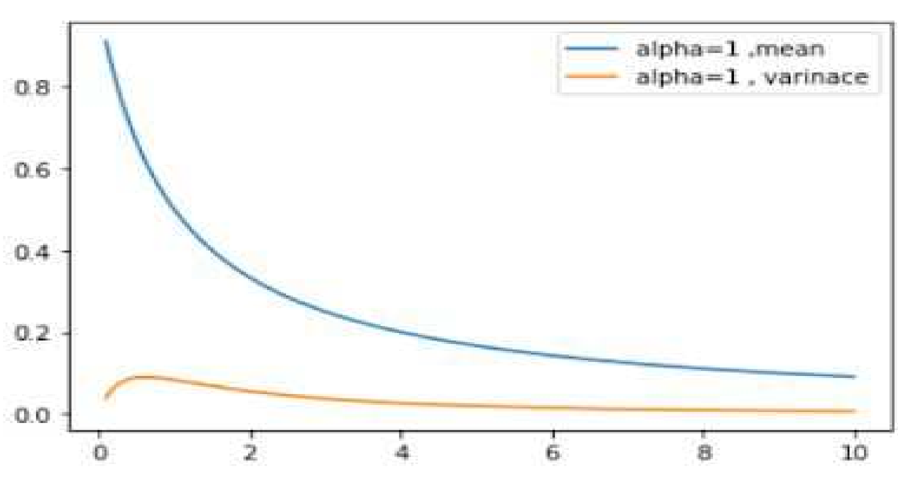
First part:
Alpha, beta are the parameters
Using **Probability density function:**
f(x) =(a+b-1)! /((a-1)!*(b-1)!) * (x^(a-1) * (1-x)^(b-1))
We plot the beta distribution by changing the parameter alpha,beta

Using **mean= a/(a+b) , variance=(a*b)/((a+b)*(a+b)*(a+b+1))**
We plot different graphs by changing mean and variance accordingly.

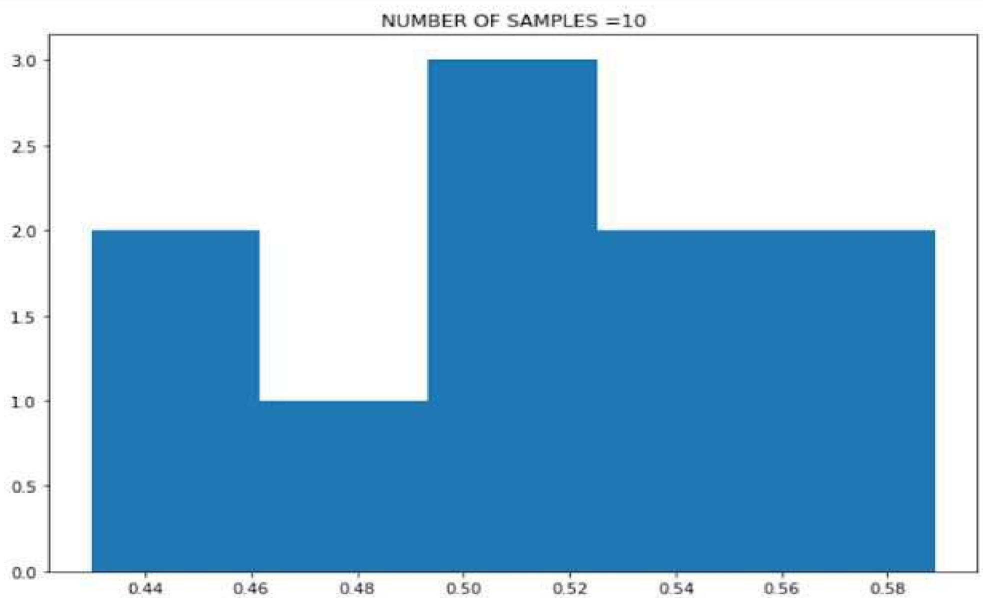


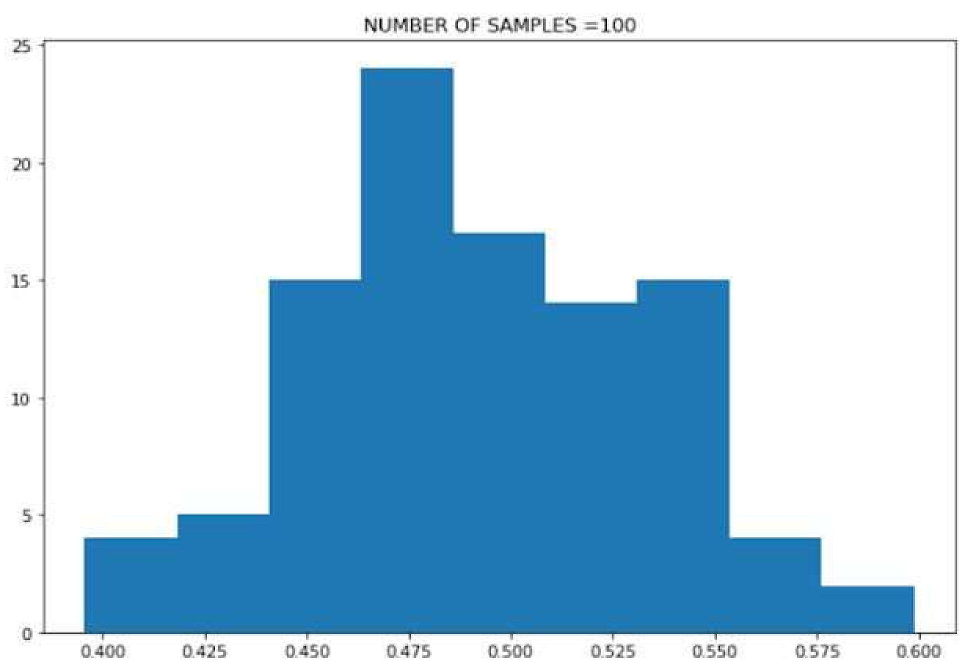

a=1 b=1
a=2 b=1
a=3 b=1
a=4 b=1
beta distribution

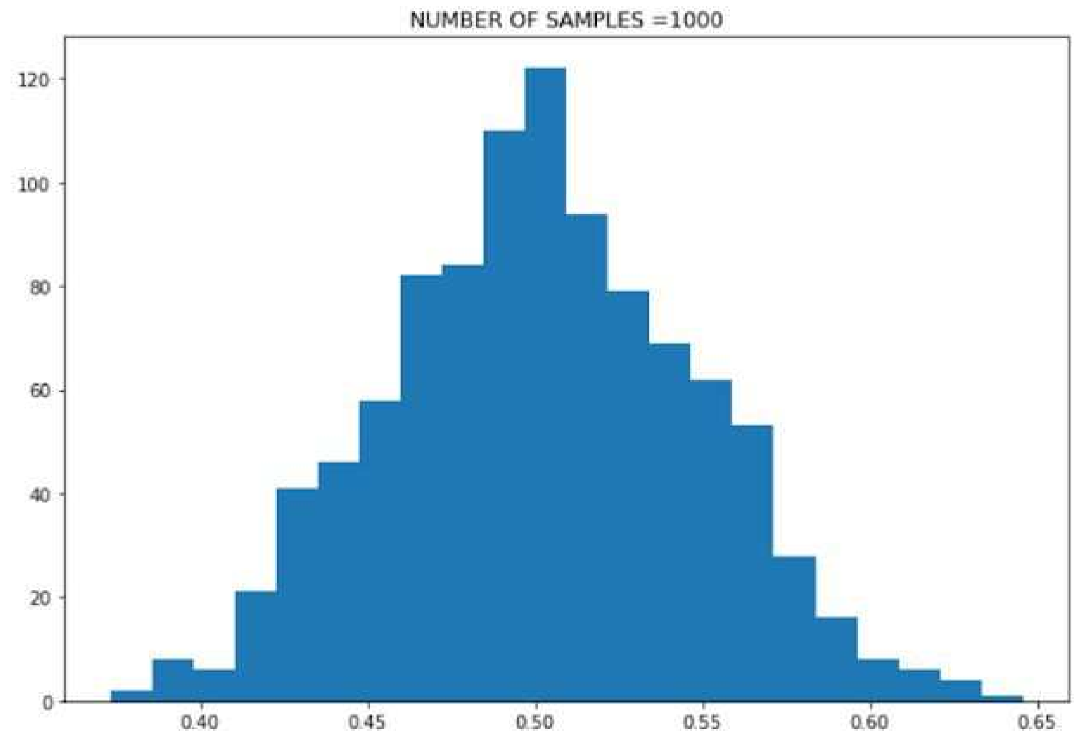

beta=1 ,mean
beta=1 , varinace

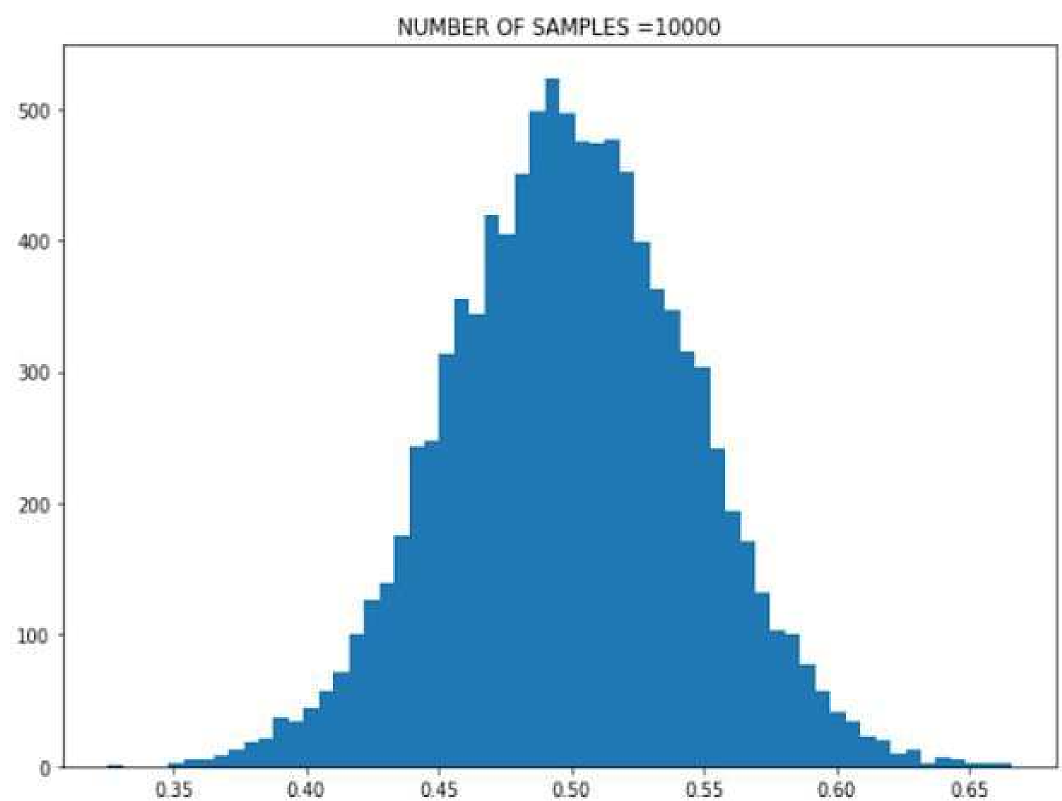

alpha=1 ,mean
alpha=1 , varinace

Second part:
Plotting graph for 40 samples
using the function **np.random.beta(alpha,beta,size)**
Plotted graphs for different values of alpha, beta and calculated mean and variances






NUMBER OF SAMPLES =1000
120
100
80
60
40
20
0
0.40
0.45
0.50
0.55
0.60
0.65

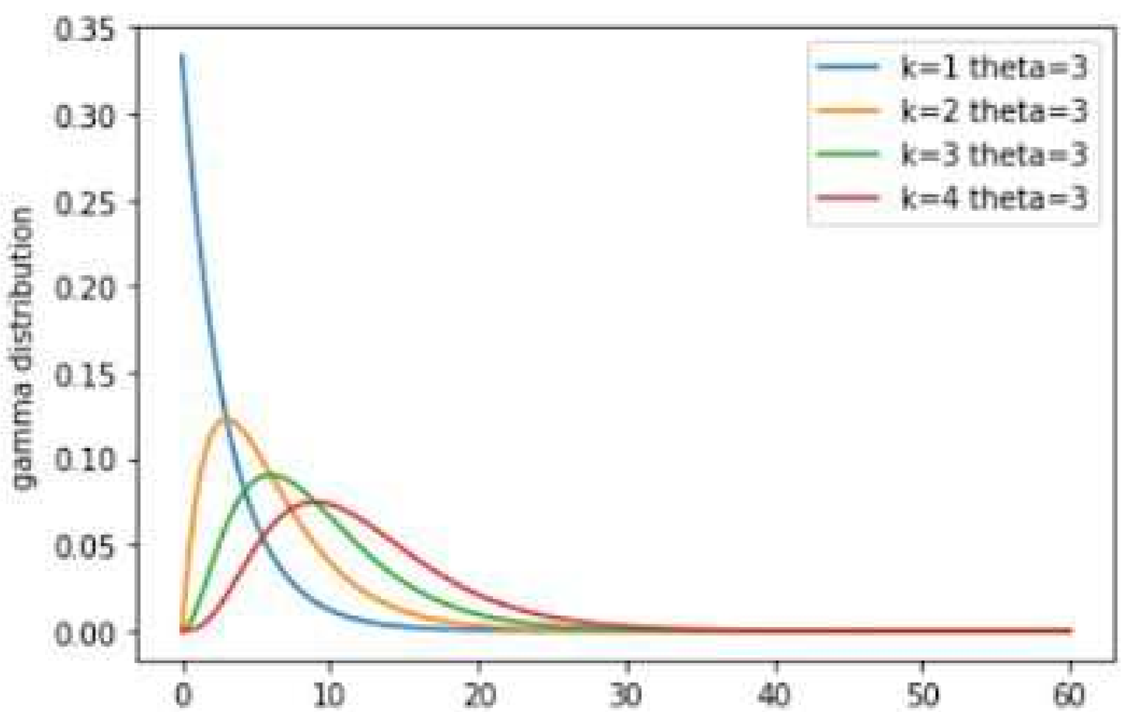

NUMBER OF SAMPLES =10000
500
400
300
200
100
0
0.35
0.40
0.45
0.50
0.55
0.60
0.65

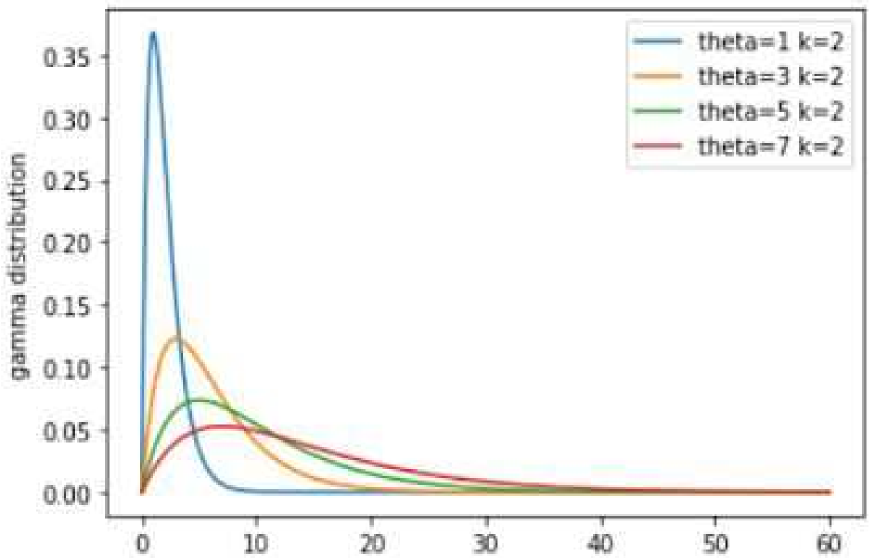
Gamma Distribution:

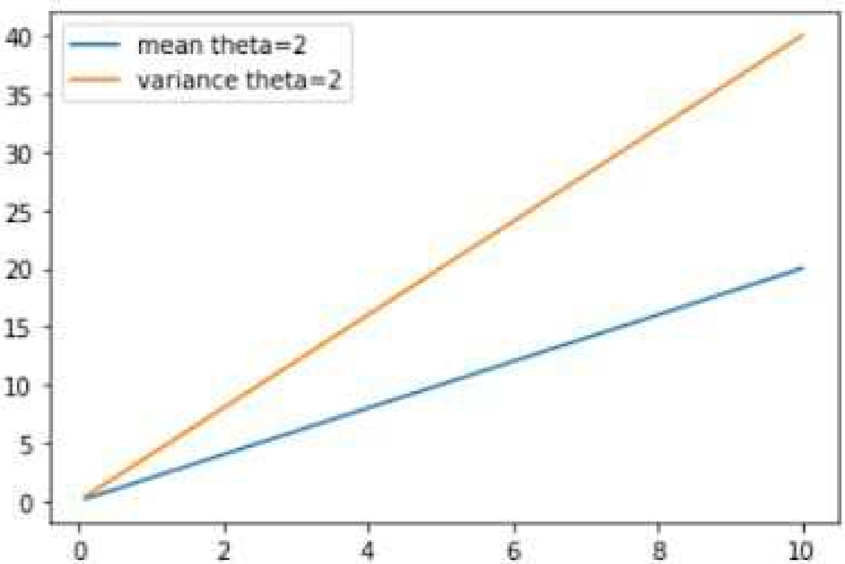
It is a two-parameter family of continuous probability distributions. With a shape parameter α = k and an inverse scale parameter β = 1/θ, called a rate parameter. ... With a shape parameter k and a mean parameter μ = kθ = α/β.

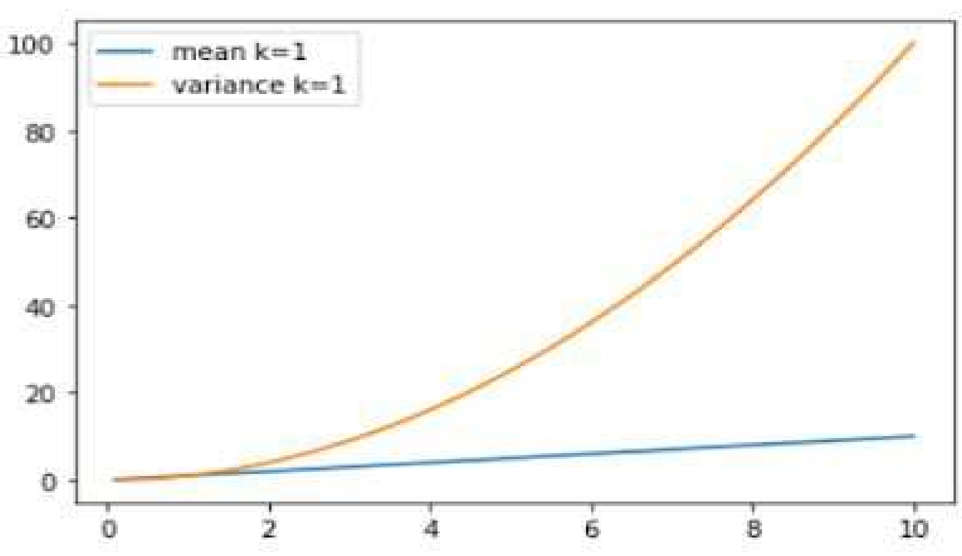
First part:
K, theta are the parameters
Using **Probability density function:**
f(x)= (x^(k-1)*exp(-x/theta))/((k-1)!*(theta^k))
We plot the gamma distribution by changing the parameter k,theta

Using **mean= k*theta , variance=k*(theta^2)**
We plot different graphs by changing mean and variance accordingly.

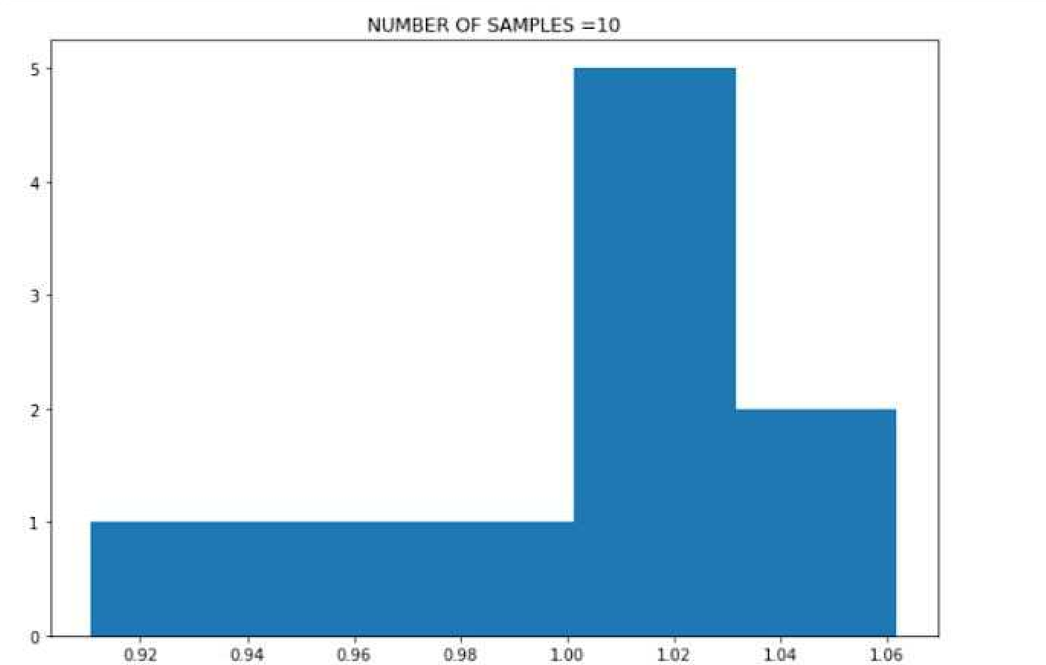


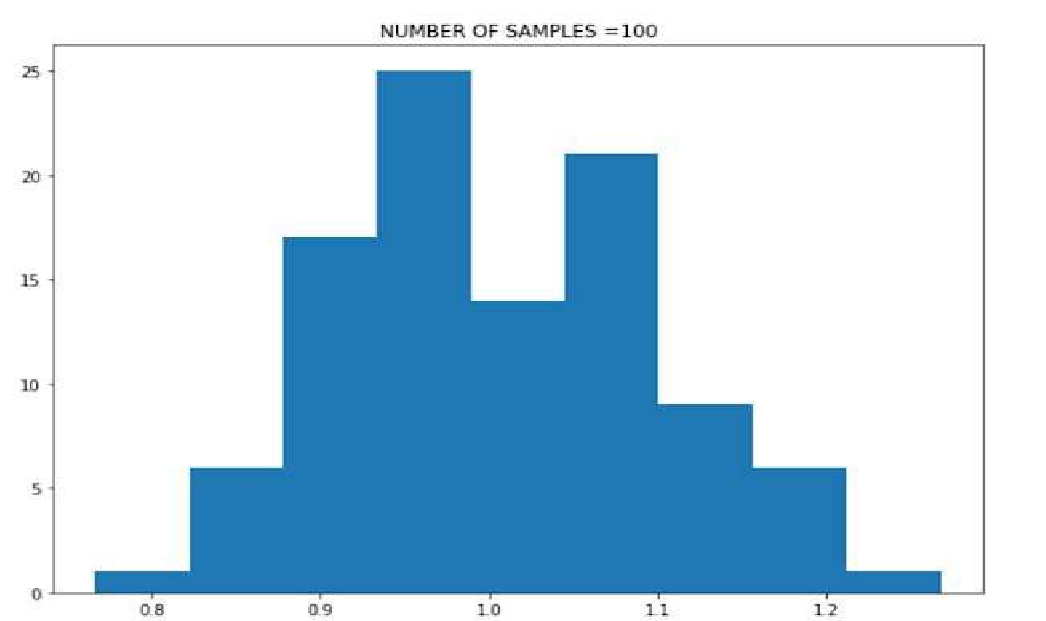

theta=1 k=2
theta=3 k=2
theta=5 k=2
theta=7 k=2
gamma distribution

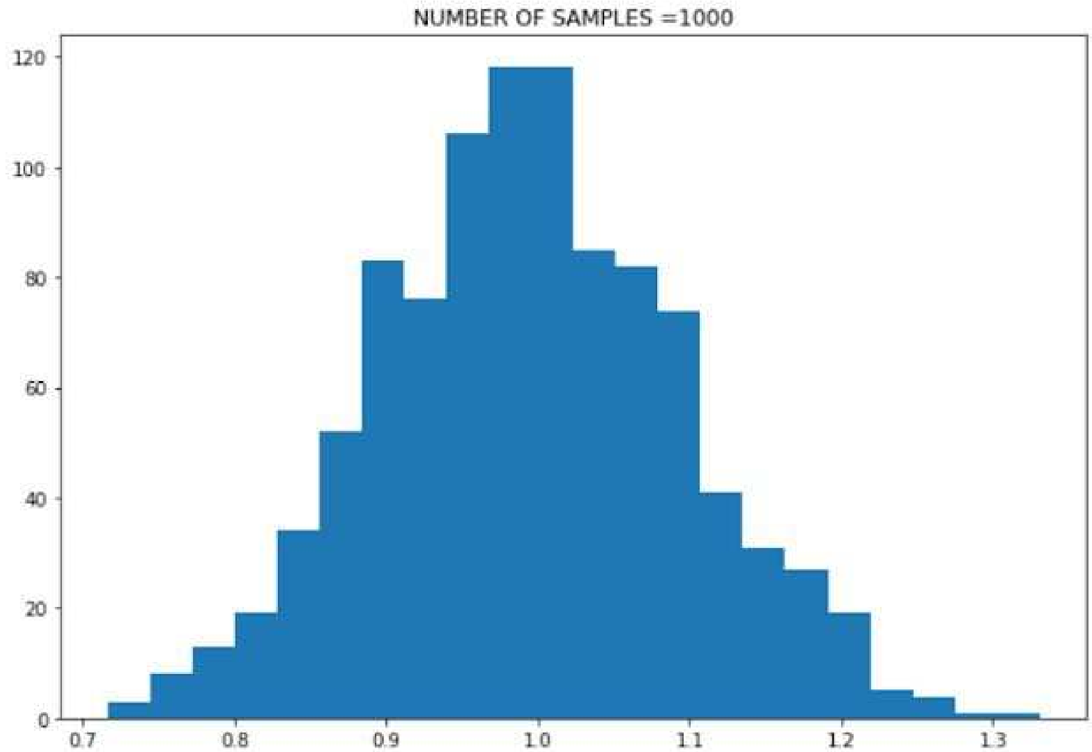

mean theta=2
variance theta=2


mean k=1
variance k=1

Second part:
Plotting graph for 40 samples
using the function **np.random.gamma(k,theta,size)**
Plotted graphs for different values of k,theta and calculated mean and variances






NUMBER OF SAMPLES =1000
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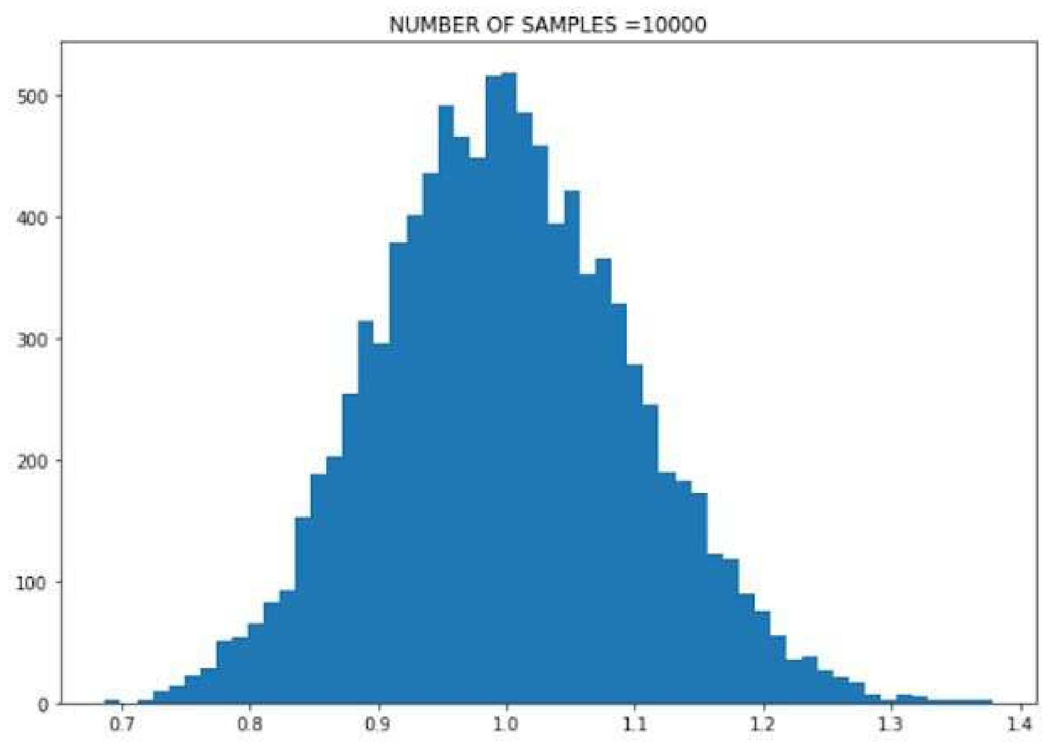
100
80
60
40
20
0
0.7
0.8
0.9
1.0
1.1
1.2
1.3

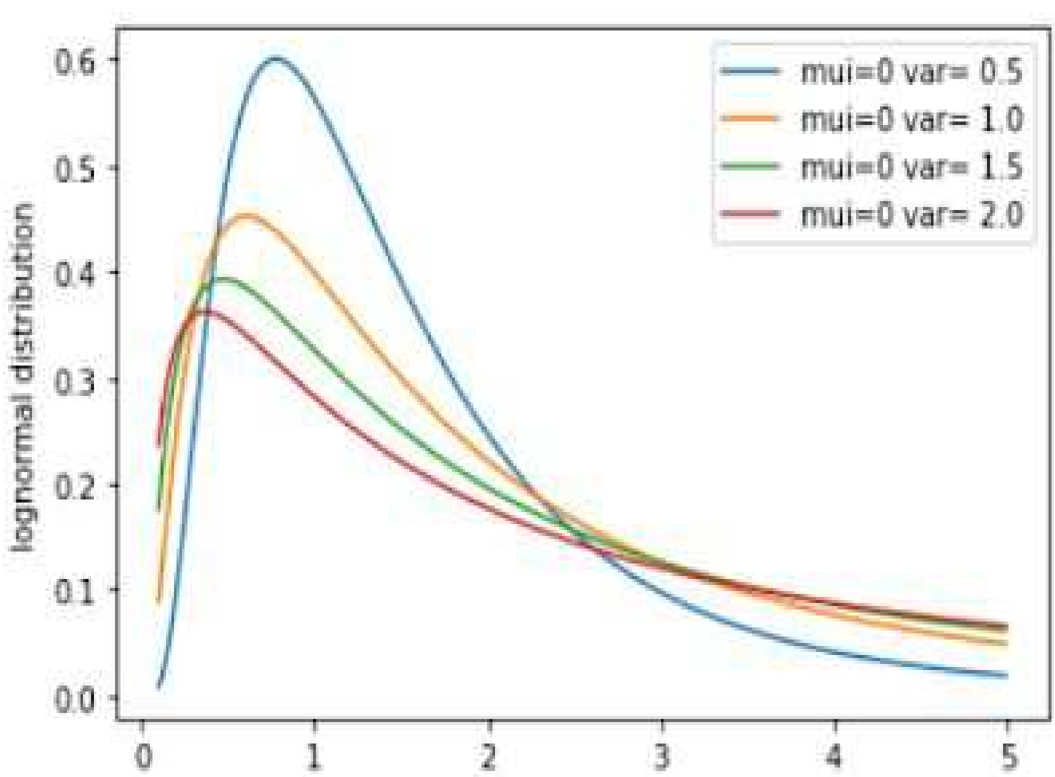

NUMBER OF SAMPLES =10000
500
400
300
200
100
0
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4

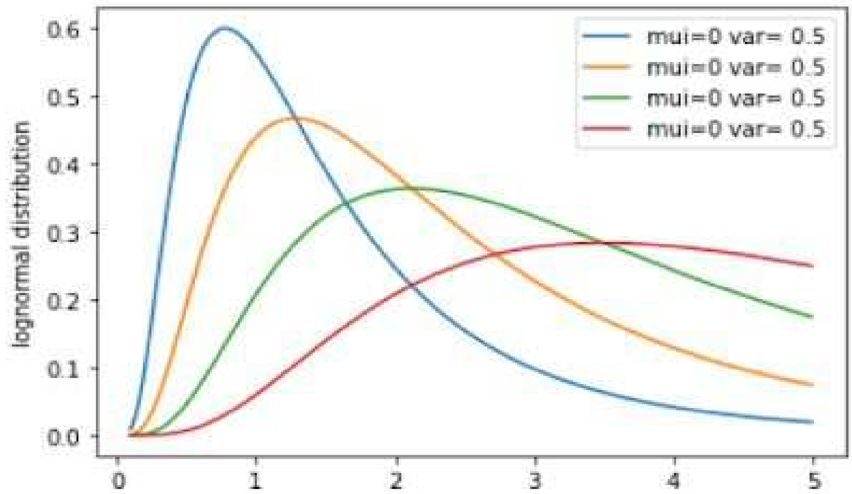
Lognormal Distribution:

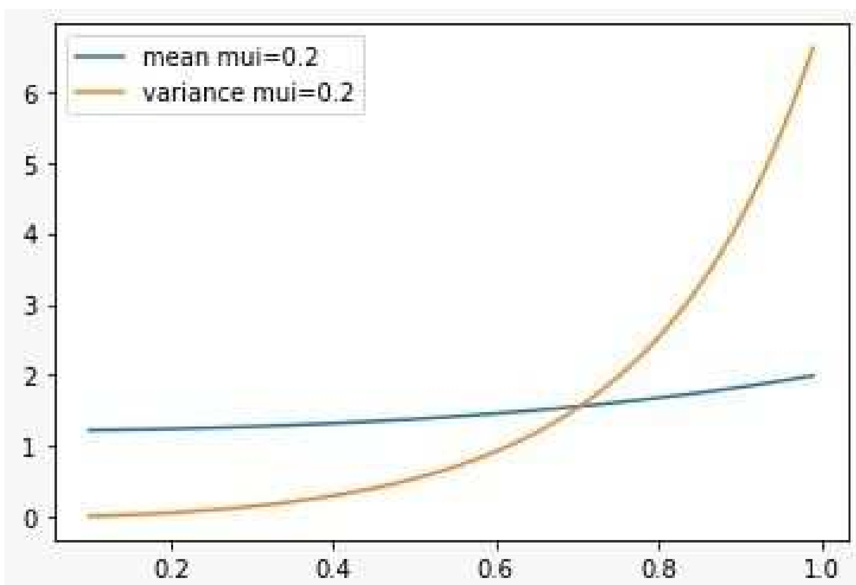
If the random variable X is log-normally distributed, then Y = ln(X) has a normal distribution.

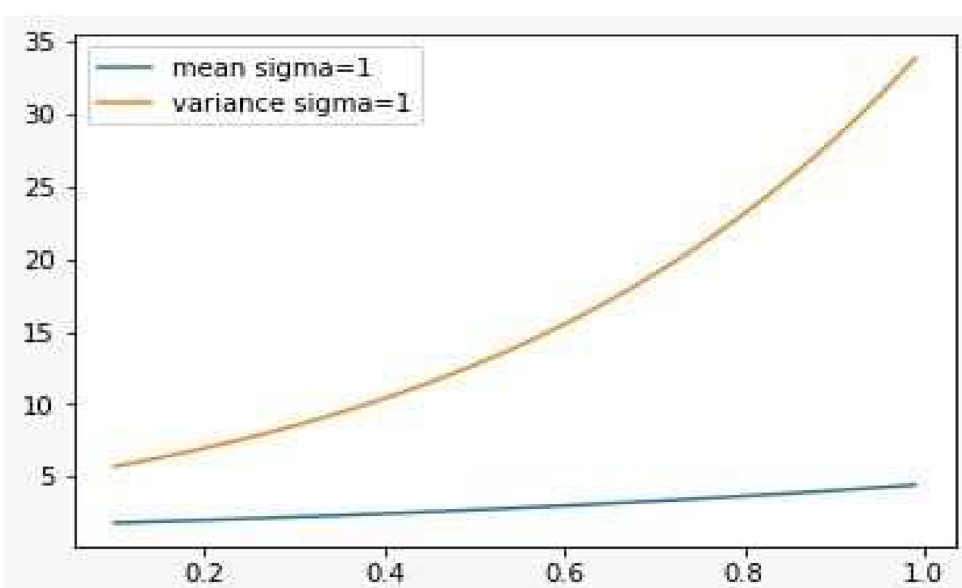
First part:
Mui, sigma are the parameters
Using **Probability density function:**
f(x)= 1/sqrt(2*pi*var*x) * exp((-1/(2*var))*(log(x)-mui)^2)
We plot the lognormal distribution by changing the parameter mui,sigma

Using **mean=exp(mui+((sigma*sigma)/2))**
vari=exp((2*mui)+(sigma*sigma))*((exp(sigma*sigma))-1)
We plot different graphs by changing mean and variance accordingly.

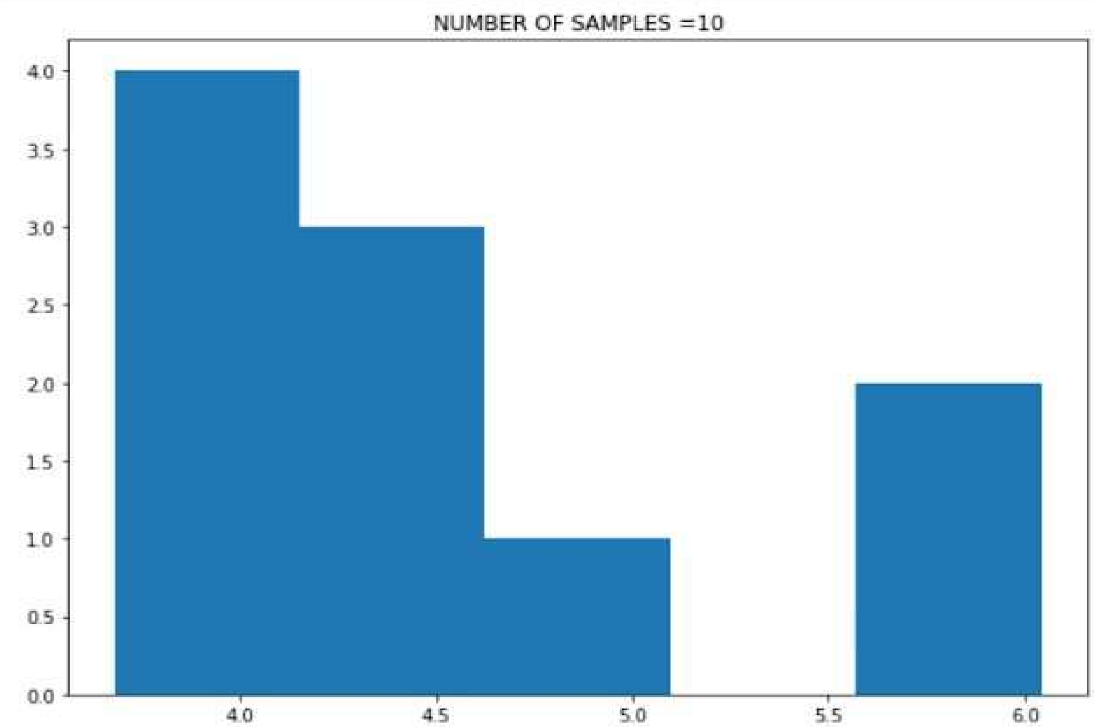


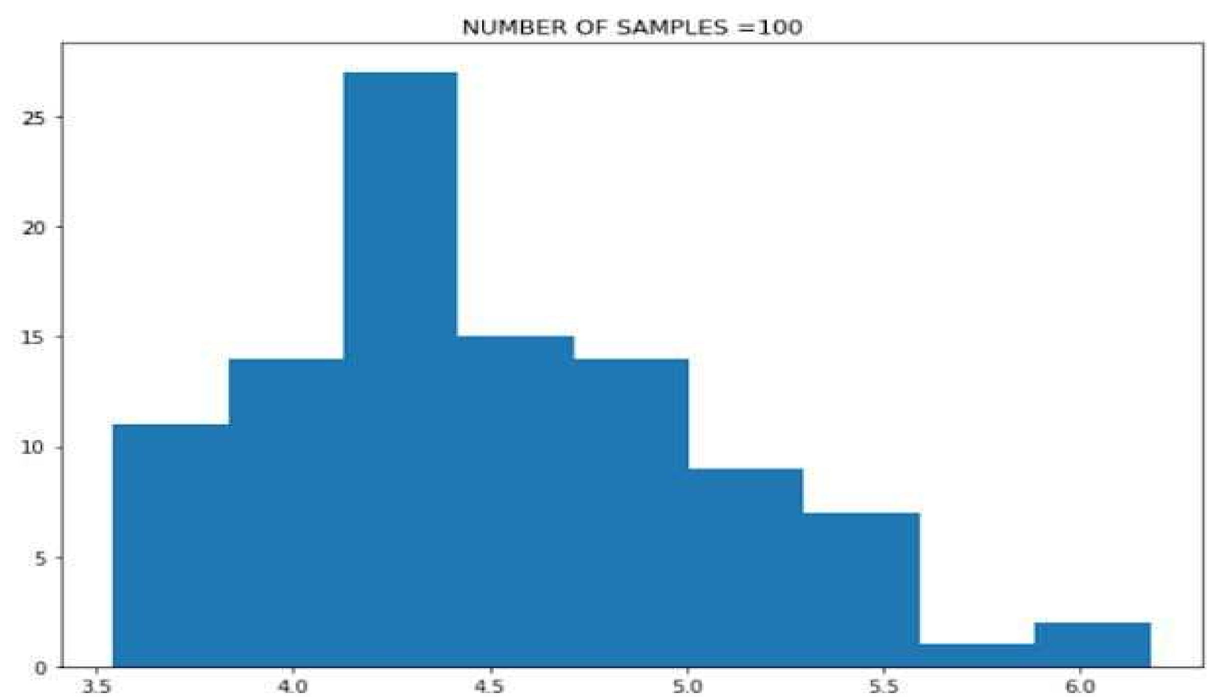

mui=0 var= 0.5
mui=0 var= 0.5
mui=0 var= 0.5
mui=0 var= 0.5
lognormal distribution
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
1
2
3
4
5

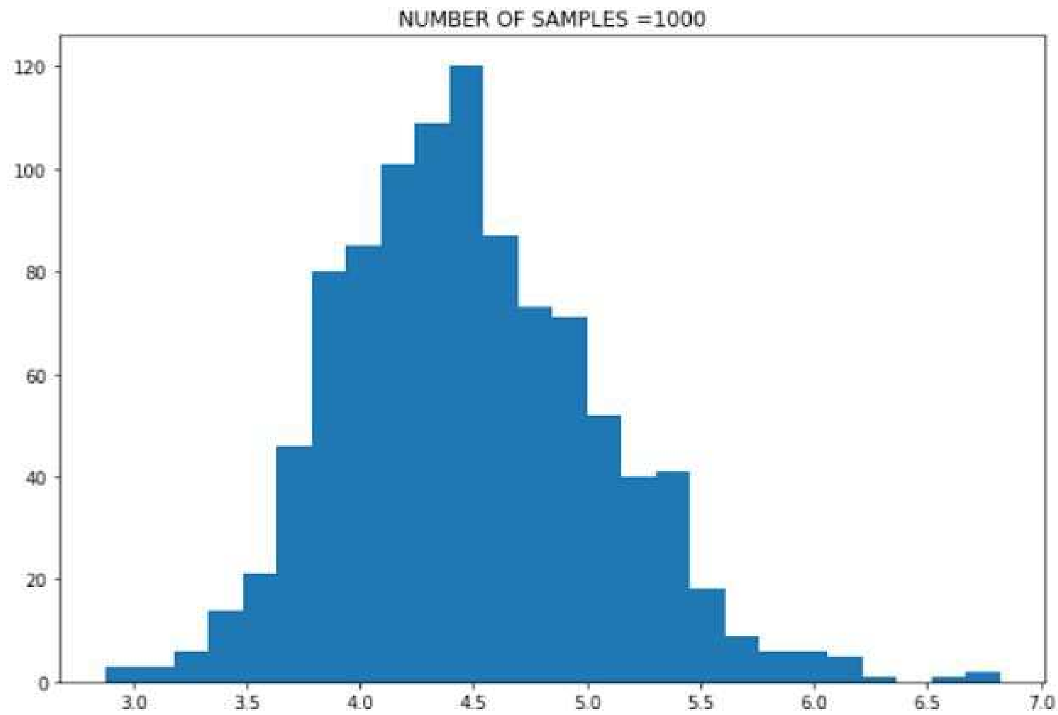

mean mui=0.2
variance mui=0.2
0
1
2
3
4
5
6
0.2
0.4
0.6
0.8
1.0


mean sigma=1
variance sigma=1
5
10
15
20
25
30
35
0.2
0.4
0.6
0.8
1.0

Second part:
Plotting graph for 40 samples
using the function **np.random.lognormal(k,theta,size)**
Plotted graphs for different values of mui,var and calculated mean and variances






NUMBER OF SAMPLES =1000
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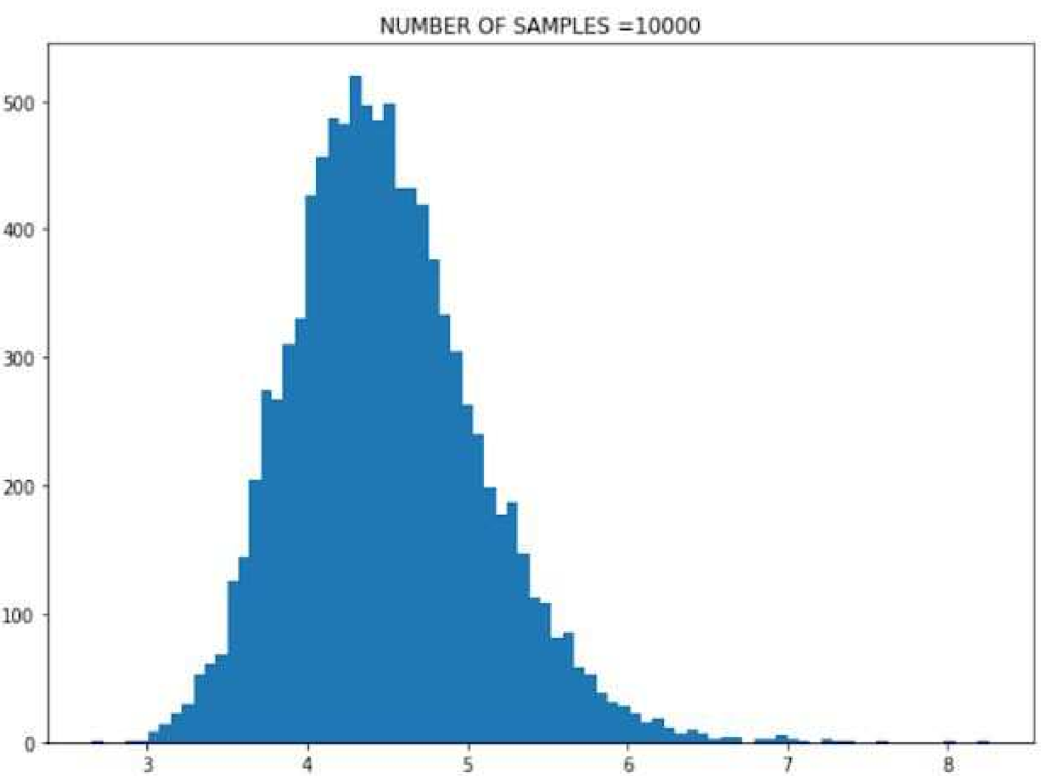
20
40
60
80
100
120
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0


NUMBER OF SAMPLES =10000
0
100
200
300
400
500
3
4
5
6
7
8