SDA Assignment 1 Report

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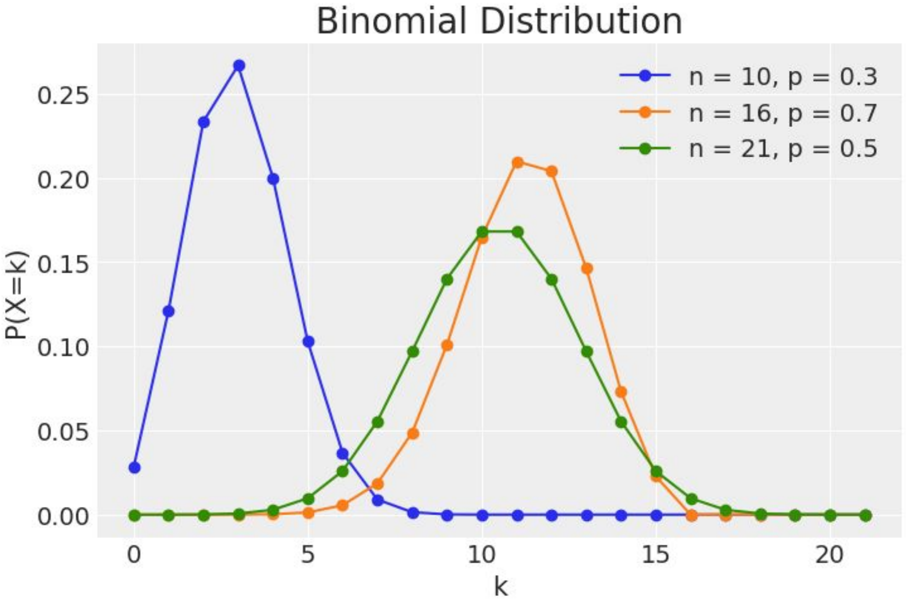
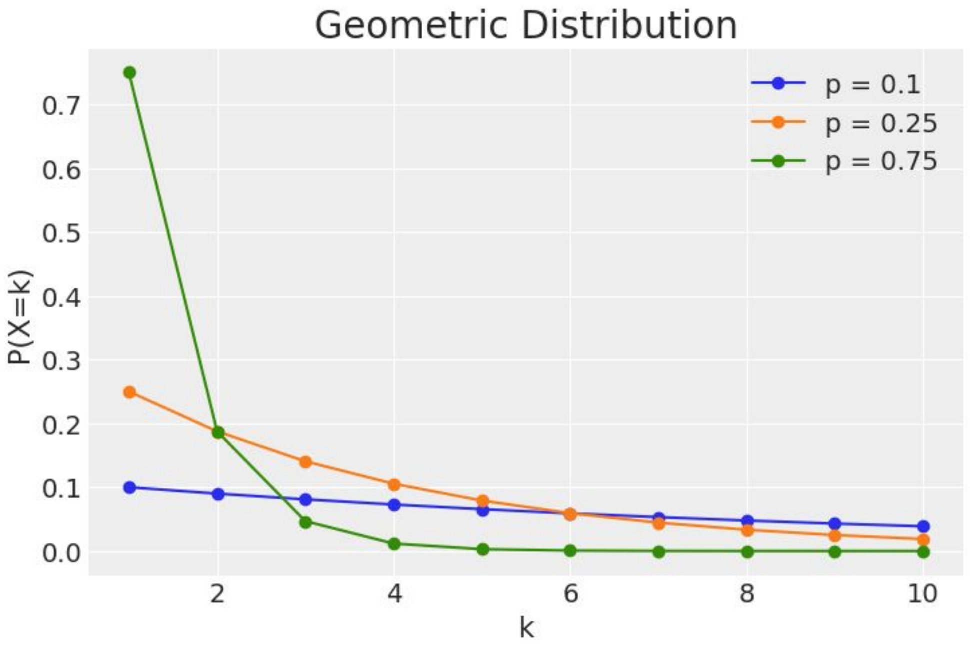
Binomial Distribution

```
X ~ Bin(n, p) => Mean: np, Variance: npq
X ~ Bin(10, 0.3) => Mean: 3.0, Variance: 2.10
X ~ Bin(16, 0.7) => Mean: 11.2, Variance: 3.36
X ~ Bin(21, 0.5) => Mean: 10.5, Variance: 5.25
```



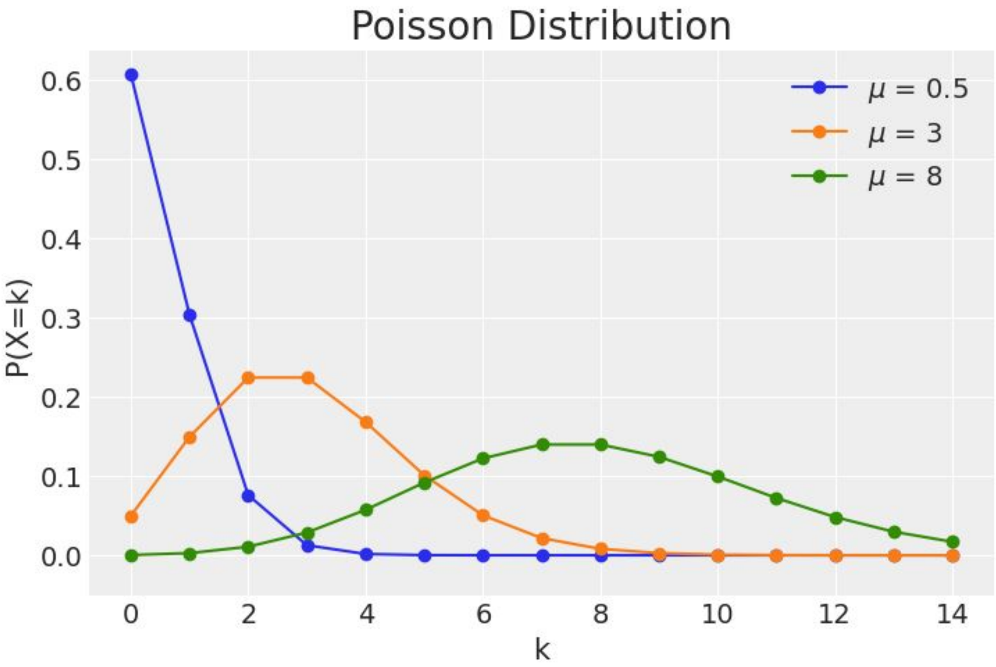
Geometric Distribution

```
X ~ Geom(p) => Mean: 1/p, Variance: (1-p)/(p*p)
X ~ Geom(0.1) => Mean: 10.00, Variance: 90.00
X ~ Geom(0.25) => Mean: 4.00, Variance: 12.00
X ~ Geom(0.75) => Mean: 1.33, Variance: 0.44
```



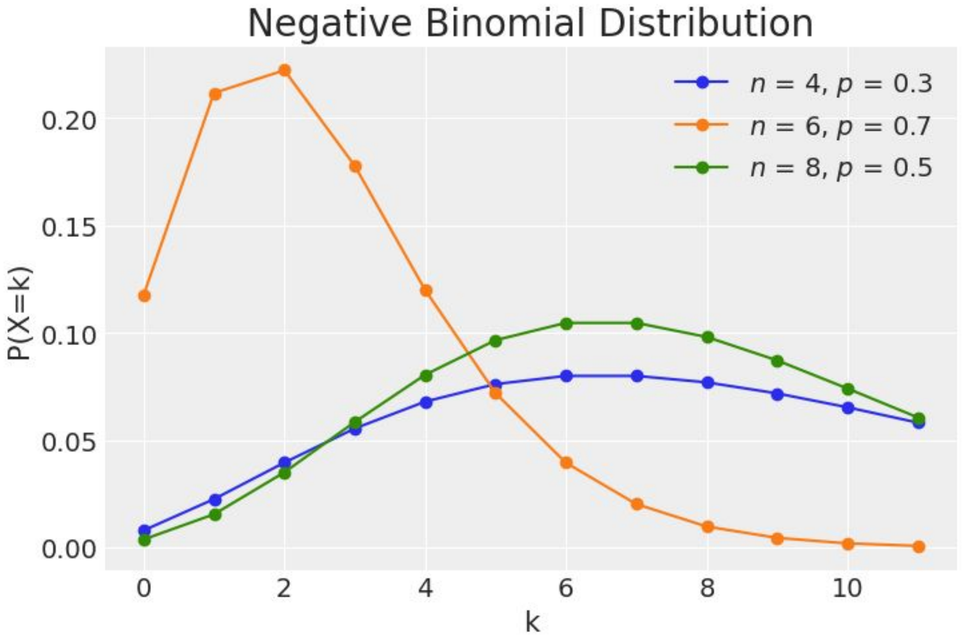
Poisson Distribution

```
X ~ Pois(lambda) => Mean: lambda, Variance: lambda
X ~ Pois(0.5) => Mean: 0.50, Variance: 0.50
X ~ Pois(3) => Mean: 3.00, Variance: 3.00
X ~ Pois(8) => Mean: 8.00, Variance: 8.00
```

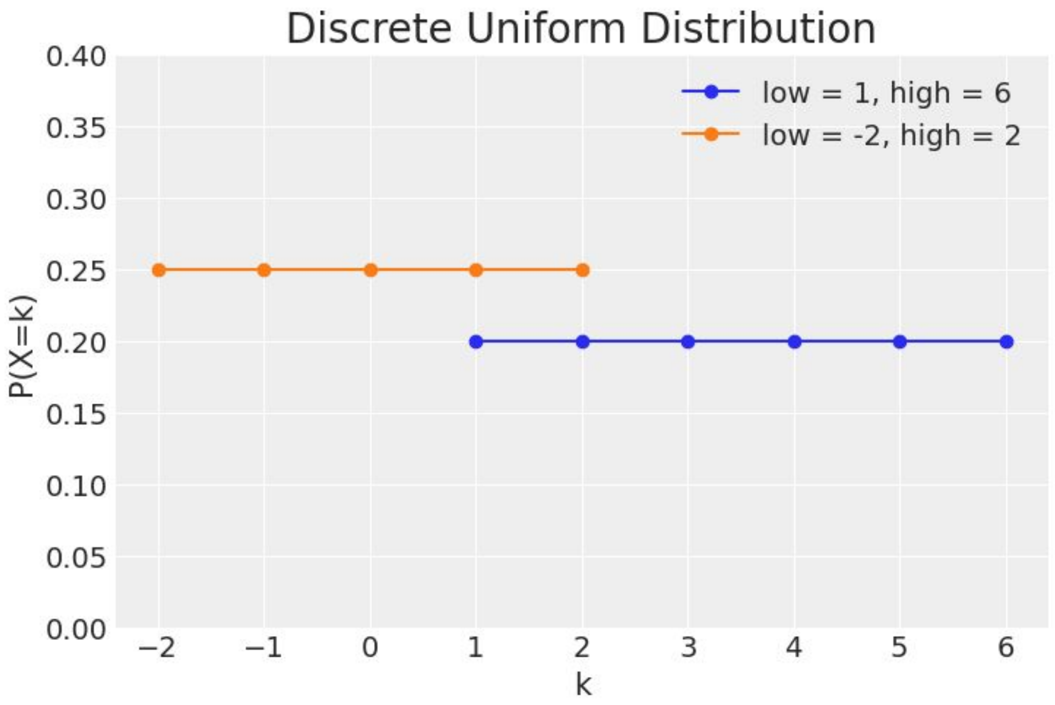


Negative Binomial Distribution

```
X ~ NB(n, p) => Mean: np/(1-p), Variance: np/(1-p)**2
X ~ NB(4, 0.3) => Mean: 1.71, Variance: 2.45
X ~ NB(6, 0.7) => Mean: 14.00, Variance: 46.67
X ~ NB(8, 0.5) => Mean: 8.00, Variance: 16.00
```



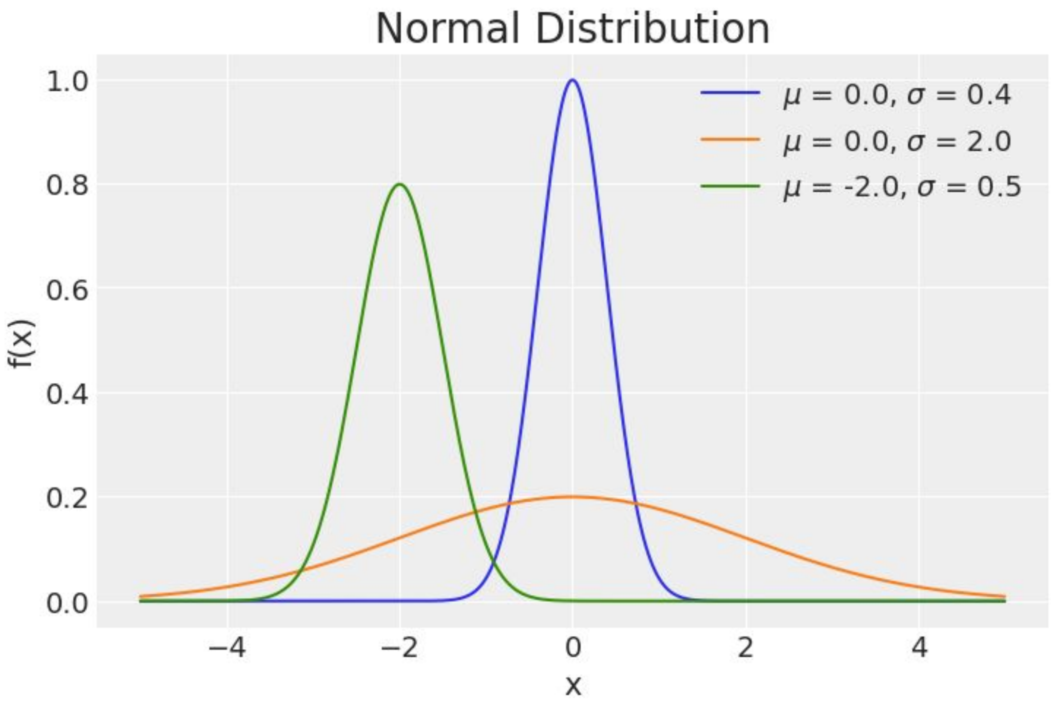
Discrete Uniform Distribution




```
X ~ Unif(low, high) => Mean: (low+high)/2, Variance: ((high-low+1)**2-1) / 12
X ~ Unif(1, 6) => Mean: 3.50, Variance: 2.92
X ~ Unif(-2, 2) => Mean: 0.00, Variance: 2.00
```

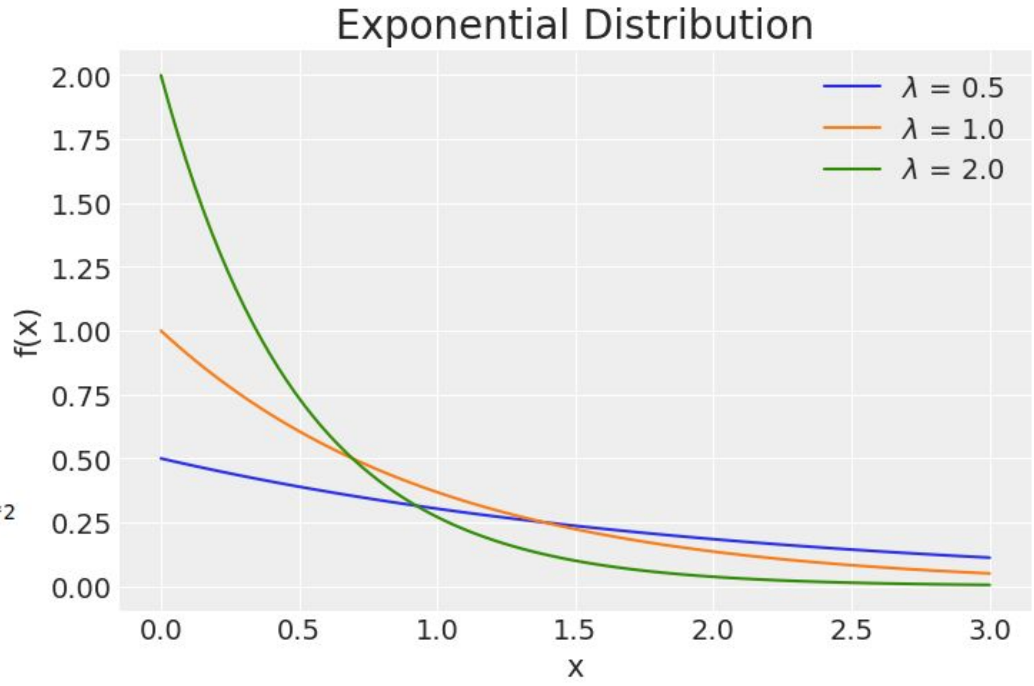
Normal Distribution

```
X ~ N(mu, sigma**2) => Mean: mu, Variance: sigma**2
X ~ N(0.0, 0.16) => Mean: 0.00, Variance: 0.16
X ~ N(0.0, 4.00) => Mean: 0.00, Variance: 4.00
X ~ N(-2.0, 0.25) => Mean: -2.00, Variance: 0.25
```



Exponential Distribution

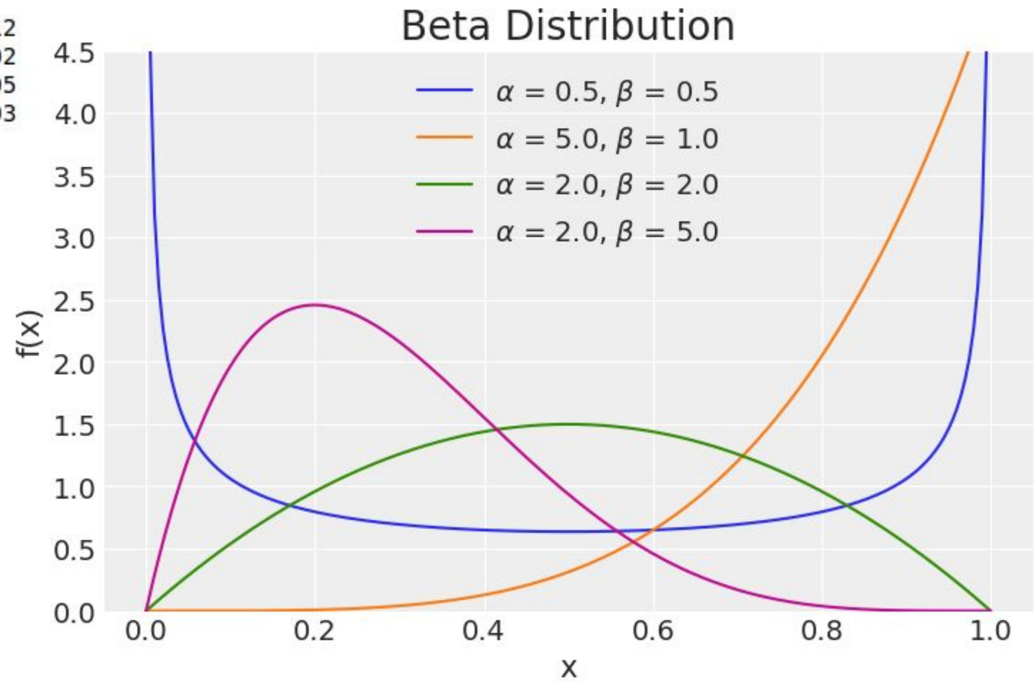
```
X ~ Expon(lambda) => Mean: 1/lambda, Variance: 1/lambda**2
X ~ Expon(0.5) => Mean: 2.00, Variance: 4.00
X ~ Expon(1.0) => Mean: 1.00, Variance: 1.00
X ~ Expon(2.0) => Mean: 0.50, Variance: 0.25
```



Beta Distribution

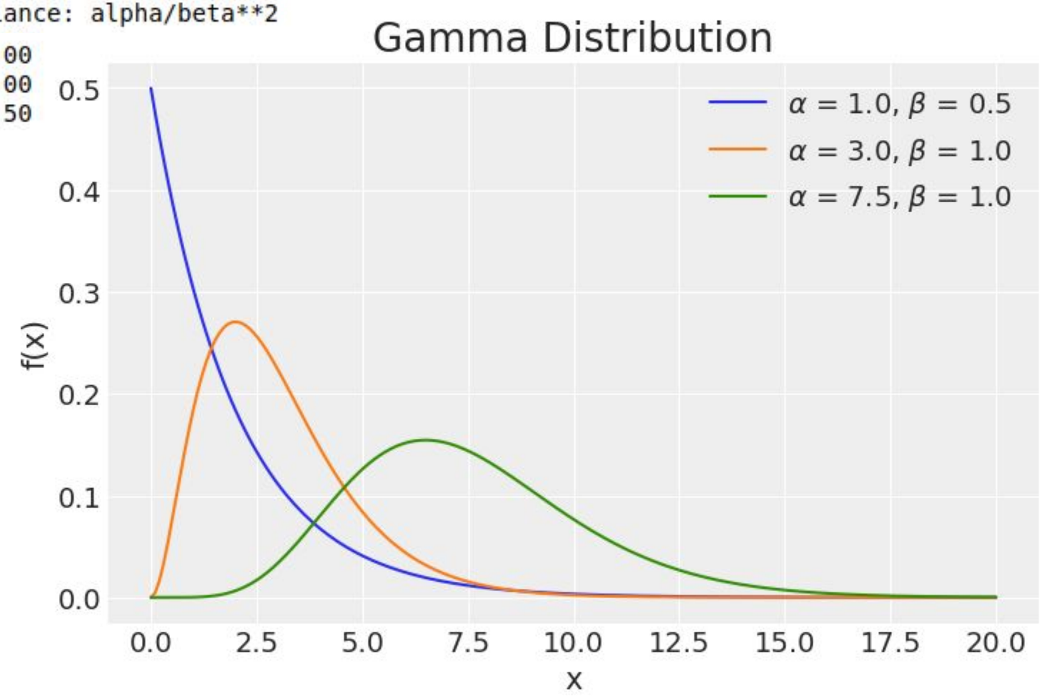
```
X ~ Beta(alpha, beta) => Mean: alpha/(alpha+beta), Variance: alpha*beta/((alpha+beta)**2 * (alpba+
```

```
X ~ Beta(0.5, 0.50) => Mean: 0.50, Variance: 0.12
X ~ Beta(5.0, 1.00) => Mean: 0.83, Variance: 0.02
X ~ Beta(2.0, 2.00) => Mean: 0.50, Variance: 0.05
X ~ Beta(2.0, 5.00) => Mean: 0.29, Variance: 0.03
```



Gamma Distribution

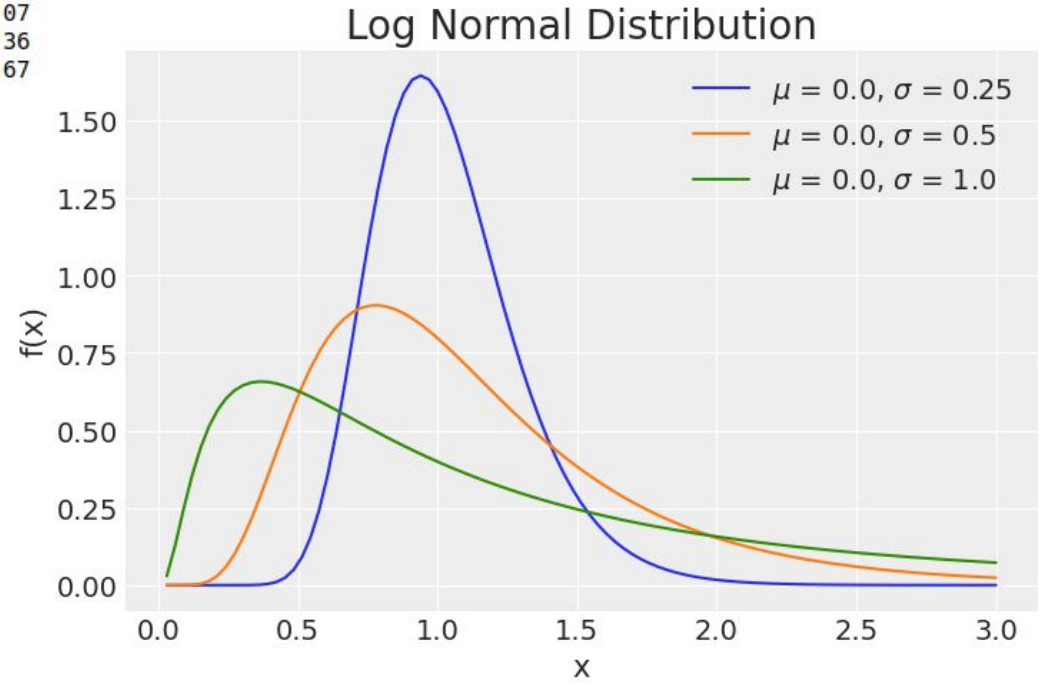
```
X ~ Gamma(alpha, beta) => Mean: alpha/beta, Variance: alpha/beta**2
X ~ Gamma(1.0, 0.50) => Mean: 2.00, Variance: 4.00
X ~ Gamma(3.0, 1.00) => Mean: 3.00, Variance: 3.00
X ~ Gamma(7.5, 1.00) => Mean: 7.50, Variance: 7.50
```



Log Normal Distribution

```
X ~ LogNorm(mu, sigma**2) => Mean: exp(mu), Variance: [exp(sigma**2)-1]*exp(2mu+sigma**2)
```

```
X ~ LogNorm(0.0, 0.06) => Mean: 1.00, Variance: 0.07
X ~ LogNorm(0.0, 0.25) => Mean: 1.00, Variance: 0.36
X ~ LogNorm(0.0, 1.00) => Mean: 1.00, Variance: 4.67
```

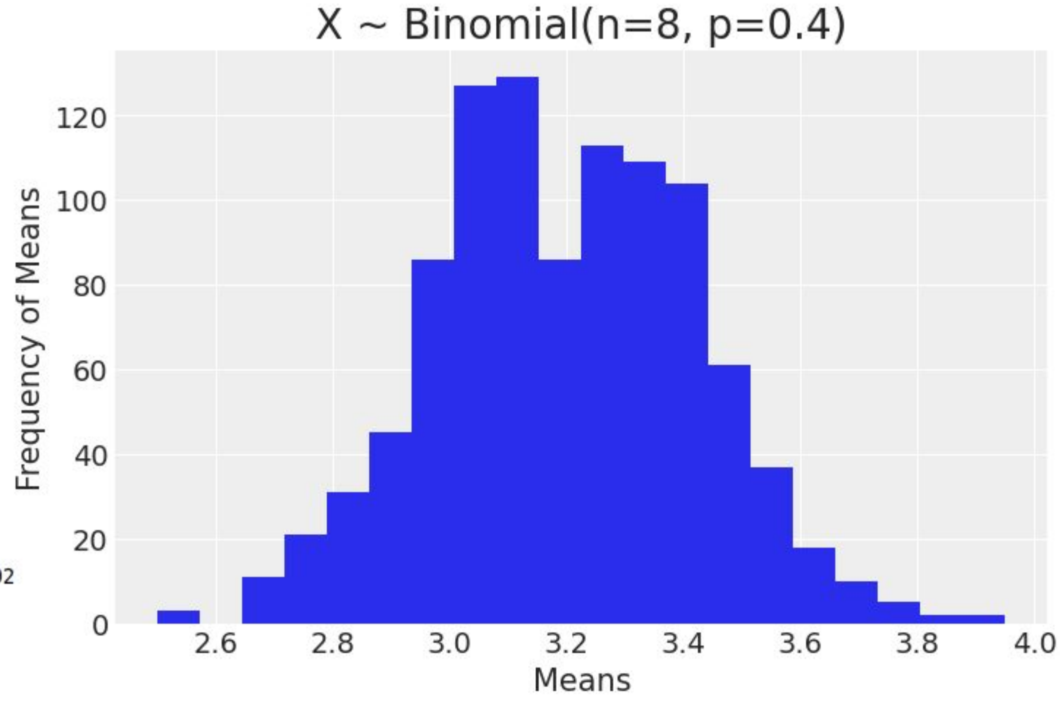


Part 2: Running 1000 Simulations Central Limit Theorem

We draw 40 samples for a distribution 1000 times and we take the mean for each of the 1000 samples and thus we have plotted the histogram for each distribution w.r.t the frequency of sample size.

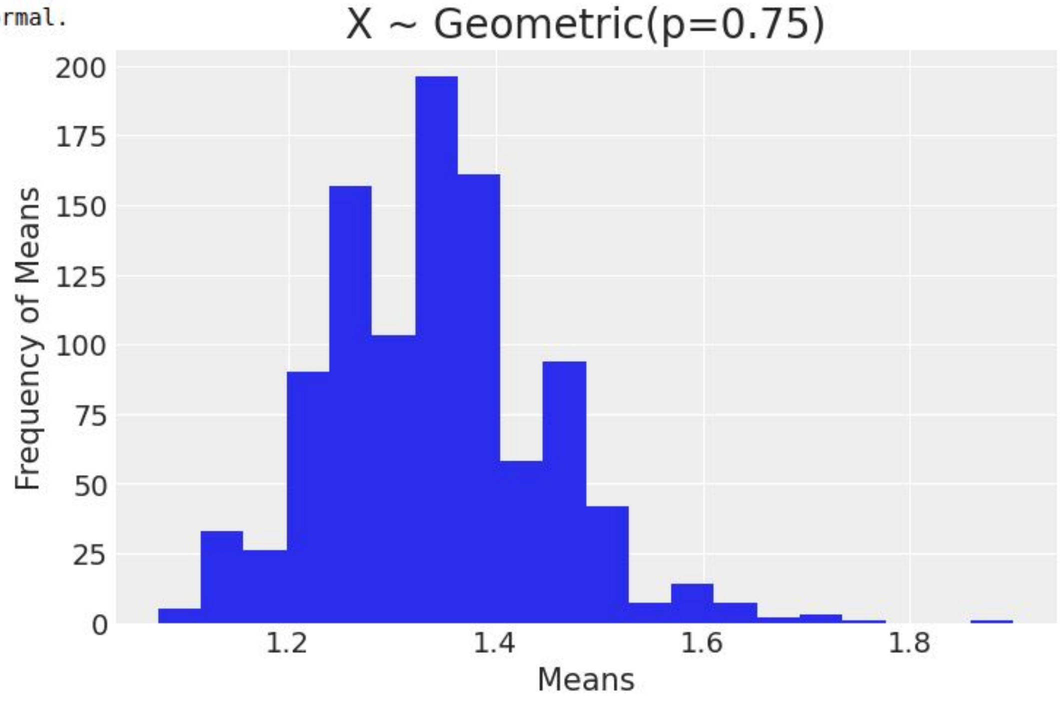
Binomial Distribution

```
X ~ Binomial(n=8, p=0.4)
The statistic sample mean = 3.196, Population mean = 3.2
The variance of sample mean = 0.049, Population variance = 1.92
Yes. The distribution of sample mean is approximately normal.
```



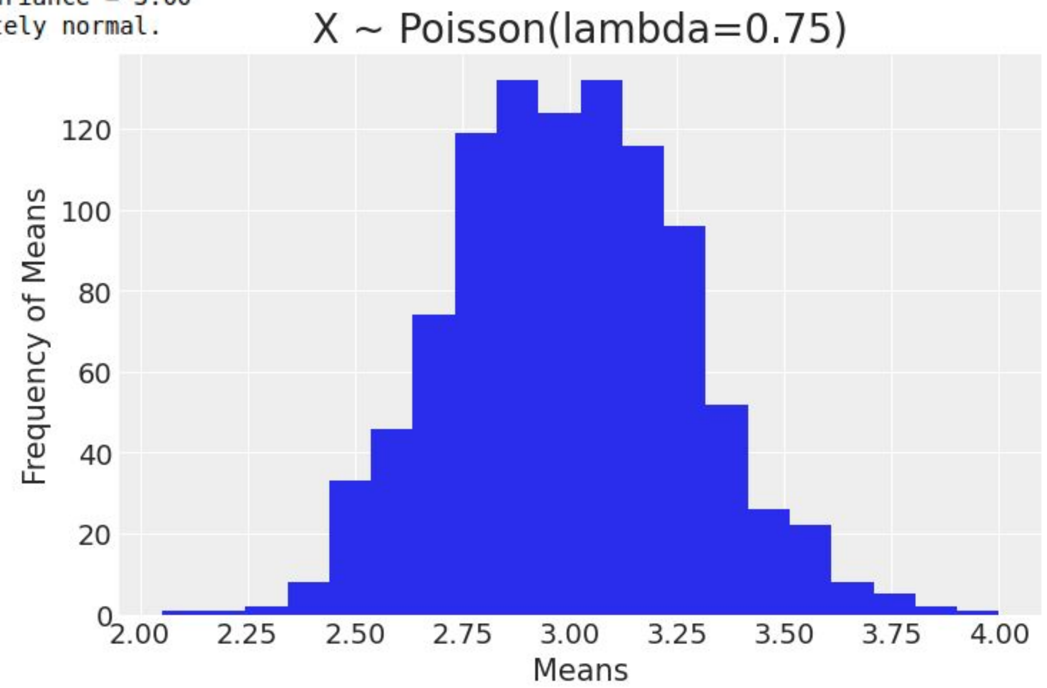
Geometric Distribution

```
X ~ Geometric(p=0.75)
The statistic sample mean = 1.340, Population mean = 1.333
The variance of sample mean = 0.011, Population variance = 0.44
Yes. The distribution of sample mean is approximately normal.
```



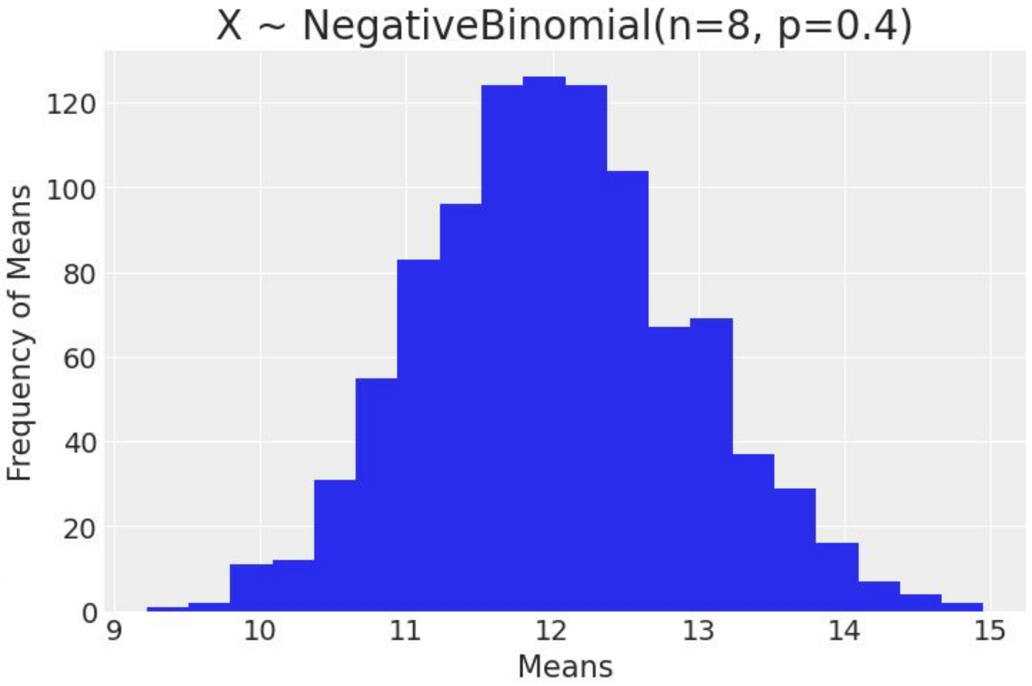
Poisson Distribution

```
X ~ Poisson(lambda=0.75)
The statistic sample mean = 2.997, Population mean = 3.000
The variance of sample mean = 0.074, Population variance = 3.00
Yes. The distribution of sample mean is approximately normal.
```

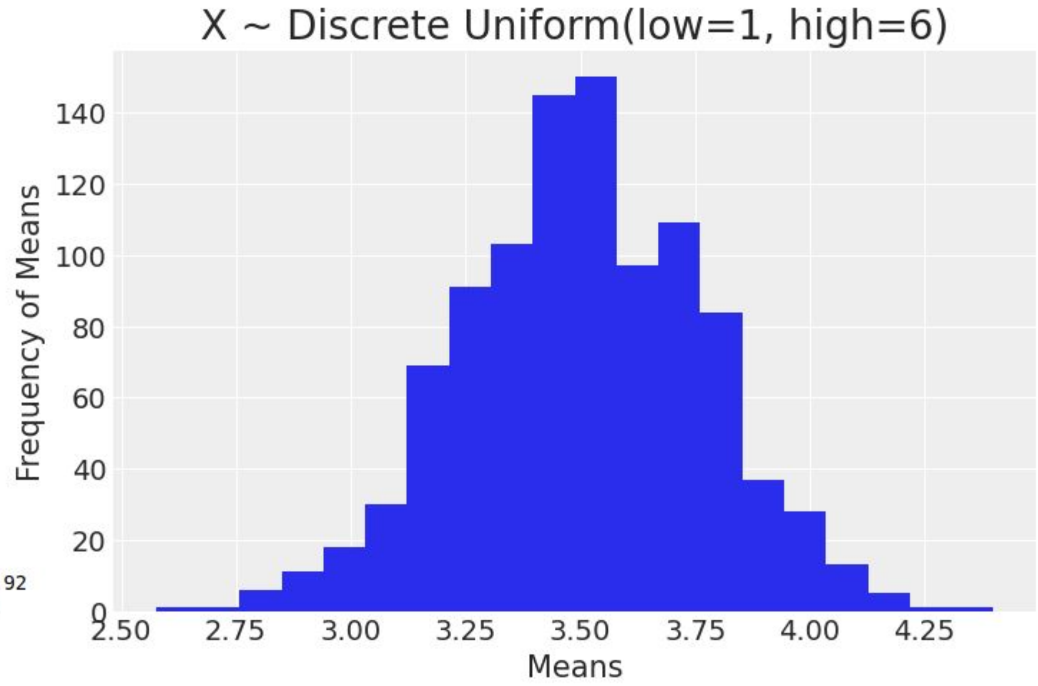


Negative Binomial Distribution

```
X ~ NegativeBinomial(n=8, p=0.4)
The statistic sample mean = 5.330, Population mean = 5.33
The variance of sample mean = 0.806, Population variance = 8.89
Yes. The distribution of sample mean is approximately normal.
```



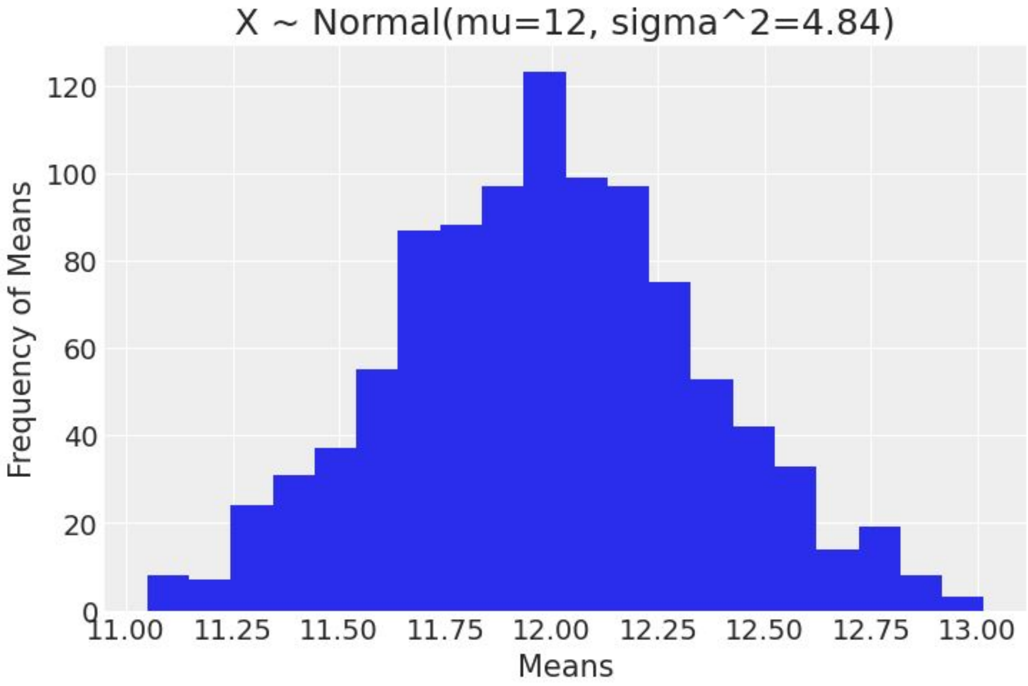
Discrete Uniform Distribution




```
X ~ DiscreteUniform(low=1, high=6)
The statistic sample mean = 3.504, Population mean = 3.50
The variance of sample mean = 0.070, Population variance = 2.92
Yes. The distribution of sample mean is approximately normal.
```

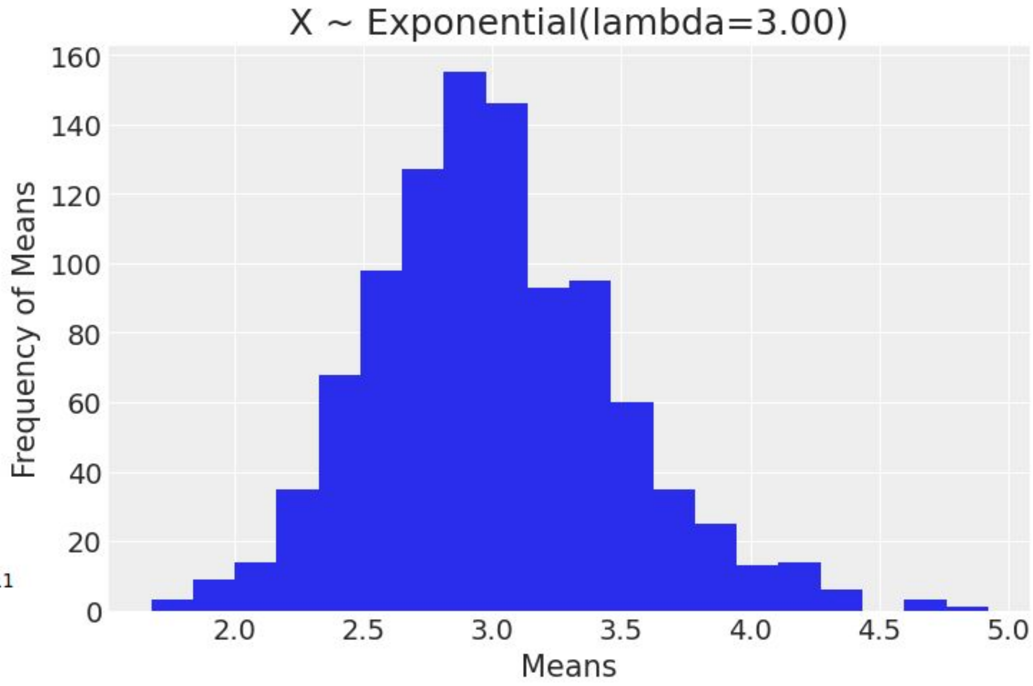
Normal Distribution

```
X ~ Normal(mu=12, sigma^2=4.84)
The statistic sample mean = 11.989, Population mean = 12.00
The variance of sample mean = 0.129, Population variance = 4.84
Yes. The distribution of sample mean is approximately normal.
```

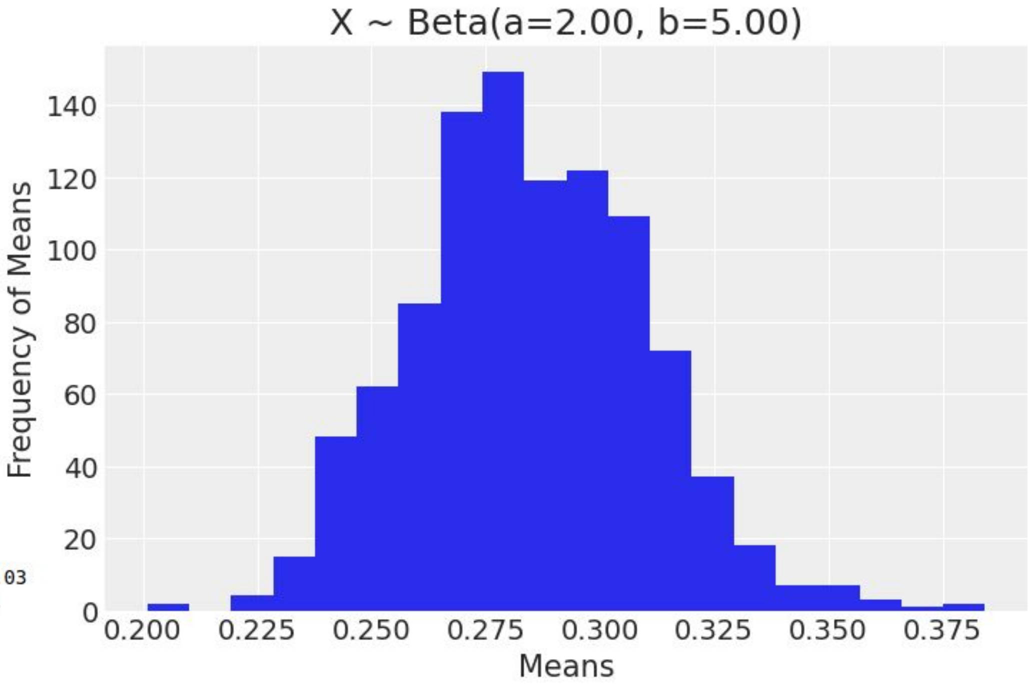


Exponential Distribution

```
X ~ Exponential(lambda=3.00)
The statistic sample mean = 3.001, Population mean = 3.00
The variance of sample mean = 0.227, Population variance = 0.11
Yes. The distribution of sample mean is approximately normal.
```



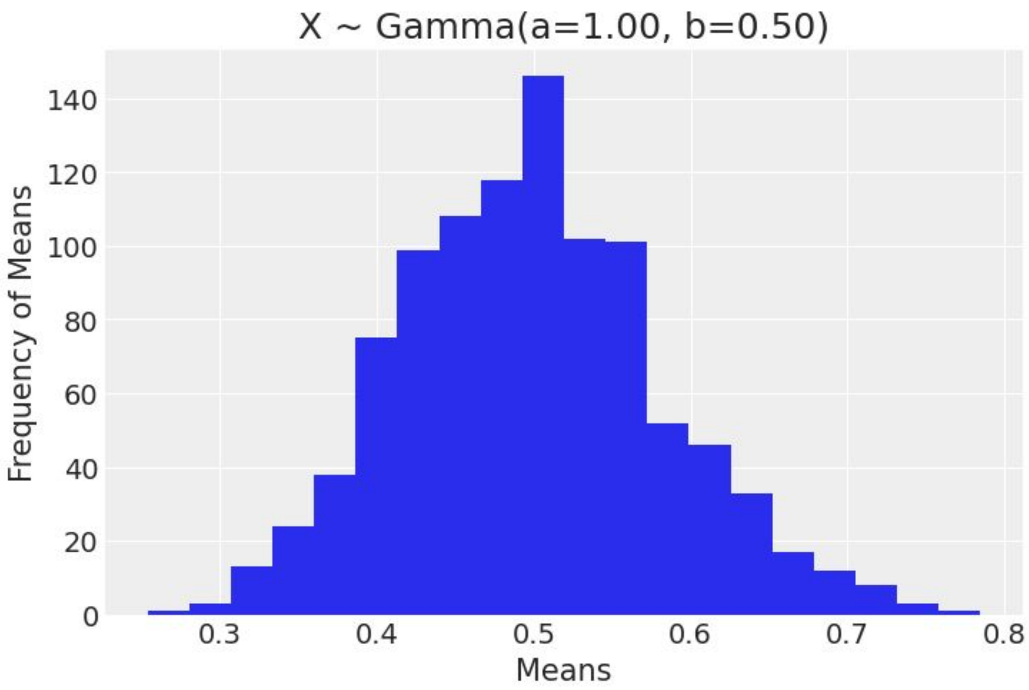
Beta Distribution



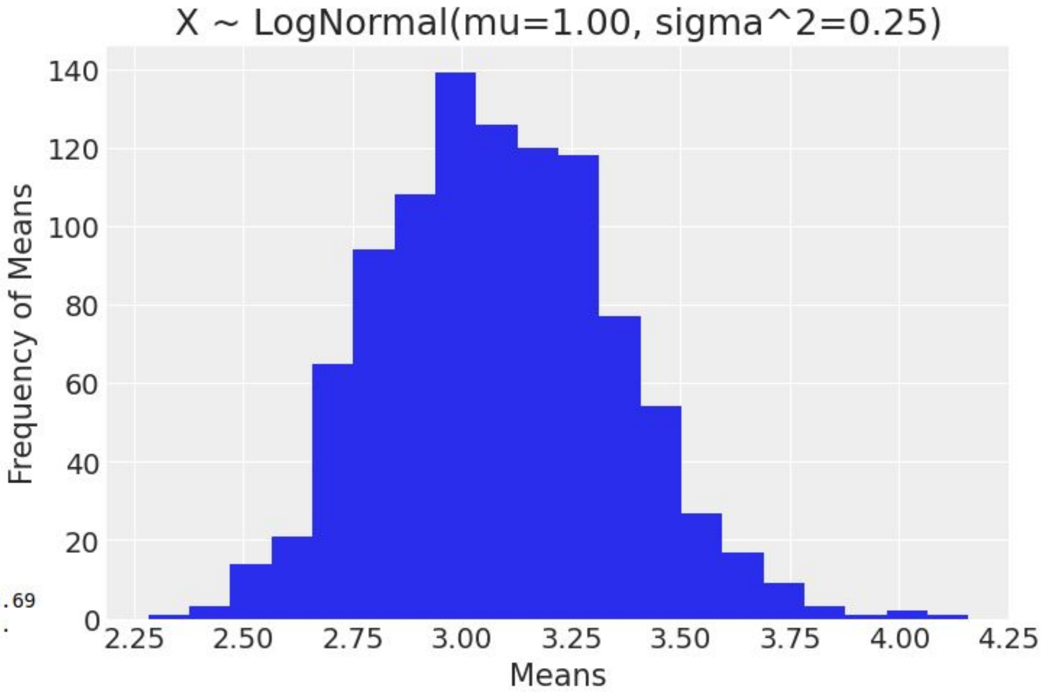

```
X ~ Beta(a=2.00, b=5.00)
The statistic sample mean = 0.285, Population mean = 0.29
The variance of sample mean = 0.001, Population variance = 0.03
Yes. The distribution of sample mean is approximately normal.
```

Gamma Distribution

```
X ~ Gamma(a=1.00, b=0.50)
The statistic sample mean = 0.499, Population mean = 0.50
The variance of sample mean = 0.007, Population variance = 4.00
Yes. The distribution of sample mean is approximately normal.
```



Log Normal Distribution




```
X ~ LogNormal(mu=1.00, sigma^2=0.25)
The statistic sample mean = 3.084, Population mean = 2.72
The variance of sample mean = 0.071, Population variance = 2.69
Yes. The distribution of sample mean is approximately normal.
```

DONE

After running 1000 simulations for each distribution we have found that the distribution of sample mean approached the normal distribution as the sample size increases and variance of mean tends to 0. This observation applies for all distribution.