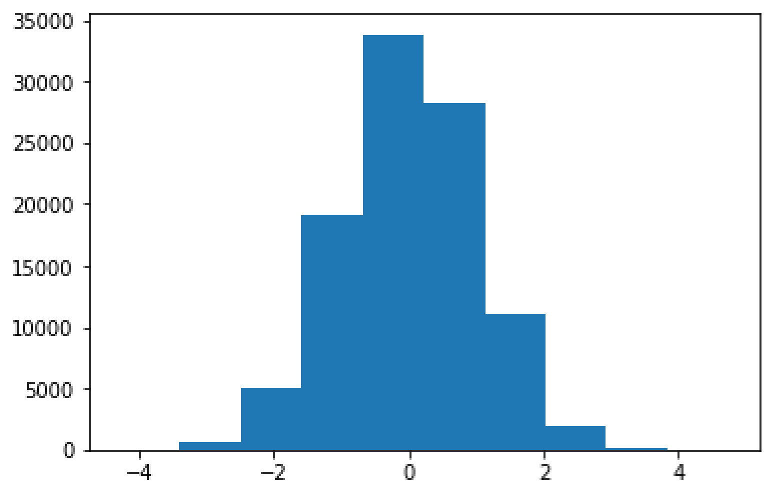
```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import math
```

Generating Random sample data in Normal Distribustion form

```
sample_data = np.random.normal(size=100000)
plt.hist(sample_data)
plt.show()  #to plot histogram without axis
```



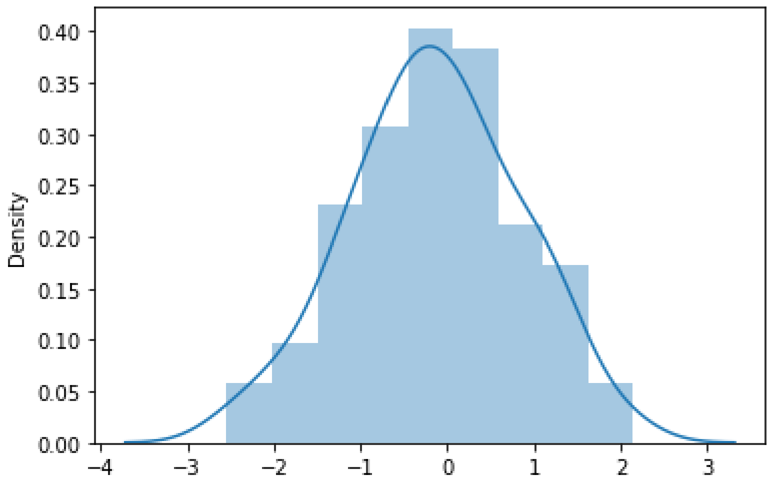

```
sns.distplot(sample_data)
#sns.displot(sample_data)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarning: `di
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f3a8e68a450>
```

Normal Dist sample data

```
sample_data = np.random.normal(size=100)
sns.distplot(sample_data)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarnin
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f3a844e6d50>
```



Uniform Dist sample data

```
sample_data= np.random.uniform(size=10000)
sns.distplot(sample_data)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarnin
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f3a844e3a10>
```

Point Estimates

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

```
np.random.seed(10)
population_ages1 =poisson.rvs(loc=18, mu=35, size=150000)  #
population_ages2 =poisson.rvs(loc=18, mu=10, size=100000)  #

population_ages = np.concatenate((population_ages1, population_ages2))  # concat

population_ages.mean() # what is the true mean age of the population of 250000  people?
```

```
43.002372
```

```
np.random.seed(6)
sample_ages = np.random.choice(a=population_ages, size=500) # Sample 500 values

sample_ages.mean() # Show sample mean     point estimate
```

```
42.388
```

```
population_ages.mean() - sample_ages.mean()
```

```
0.614372000000003
```

```
import random
```

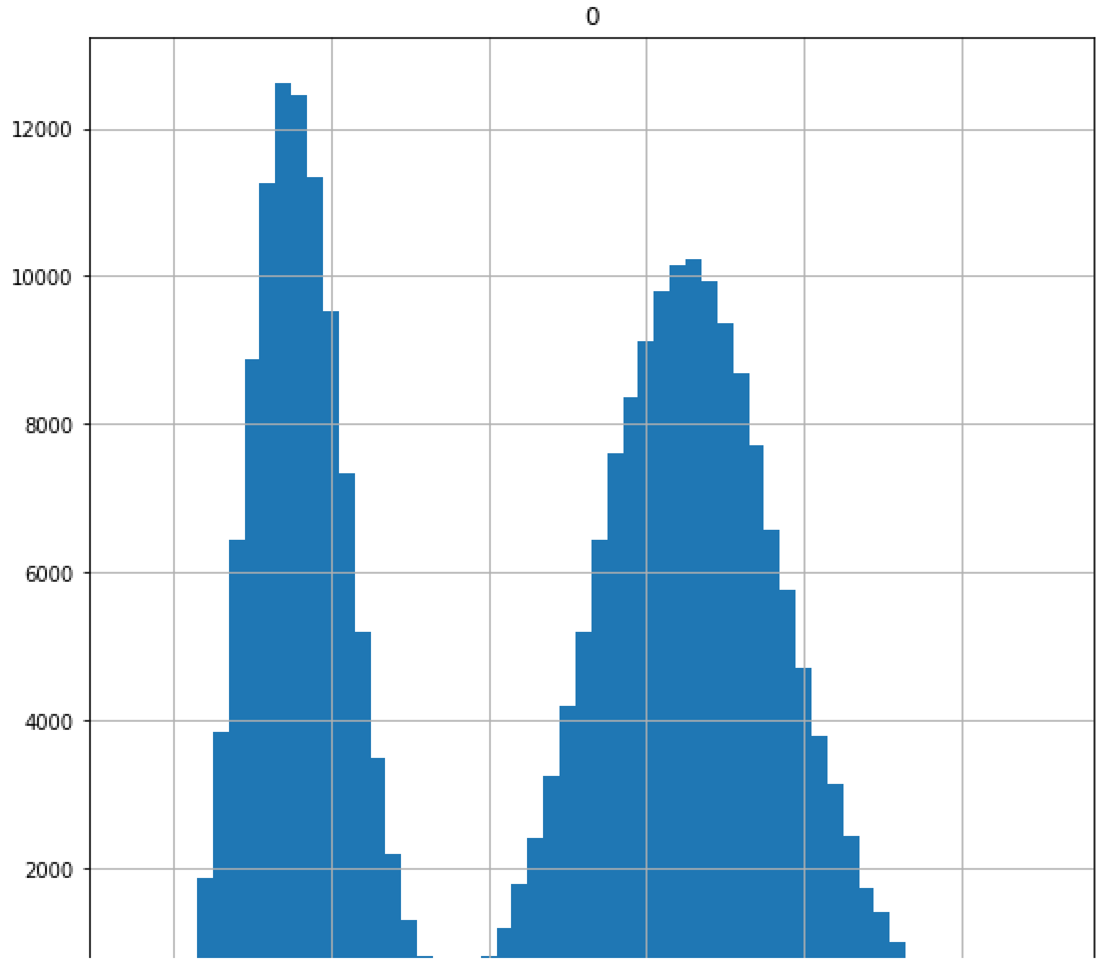
```
import pandas as pd
import scipy.stats as stats
```

Studying Sampling distribution

```
pd.DataFrame(population_ages).hist(bins=58,range=(17.5,75.5),figsize=(9,9))

print( stats.skew(population_ages) )
```

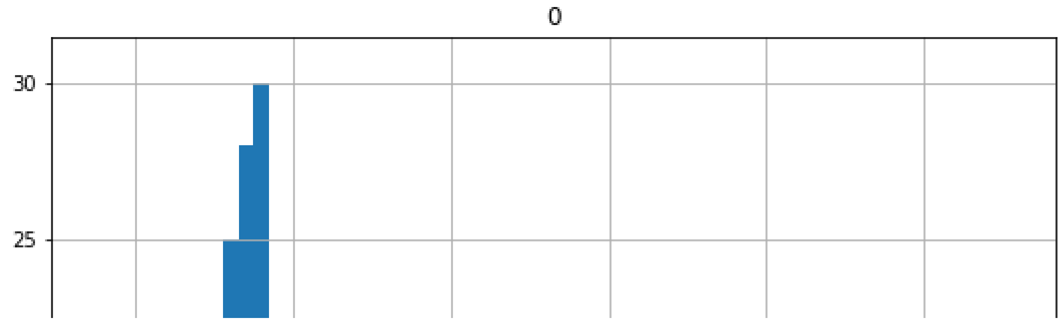
```
-0.12008483603917186
```




```
pd.DataFrame(sample_ages).hist(bins=58,range=(17.5,75.5),figsize=(9,9))

print( stats.skew(sample_ages) )
```

```
-0.056225282585406065
```



create a sampling distribution by taking 200 samples from our population and then making 200 point estimates of the mean:

Double-click (or enter) to edit

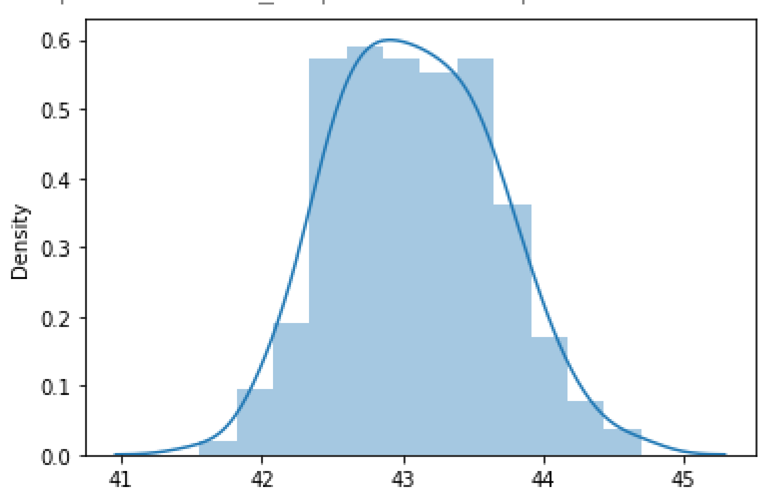
```
np.random.seed(10)     #CLT THEOREM

point_estimates = []         # Make empty list to hold point estimates

for x in range(200):         # Generate 200 samples
    sample = np.random.choice(a= population_ages, size=500)
    point_estimates.append( sample.mean() )         # collecting the sample mean for every s

#pd.DataFrame(point_estimates).plot(kind="density",  figsize=(9,9),xlim=(41,45))
sns.distplot(point_estimates)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarning: `di
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f3a83cf9110>
```




```
#The sampling distribution appears to be roughly normal, despite the bimodal population dist
#In addition, the mean of the sampling distribution approaches the true population mean
```

```
population_ages.mean() - np.array(point_estimates).mean()
```

```
-0.08440799999999626
```

Confidence Intervals

```
#S.D is known
sample_size = 1000

sample = np.random.choice(a= population_ages, size = sample_size)   #draw some random sample

sample_mean = sample.mean()  #point estimate

print(sample_mean)

z_critical = stats.norm.ppf(q = 0.975)  # Get the z-critical value*     #  area under curve

print("z-critical value:")              # Check the z-critical value
print(z_critical)

pop_stdev = population_ages.std()  # Get the population standard deviation

margin_of_error = z_critical * (pop_stdev/math.sqrt(sample_size))      #MG= Z*SIGMA/SQ(N)

confidence_interval = (sample_mean - margin_of_error, sample_mean + margin_of_error)     #X-

print("Confidence interval:")
print(confidence_interval)
```

```
43.266
z-critical value:
1.959963984540054
Confidence interval:
(42.44606406882683, 44.08593593117317)
```

```
sample_mean
```

```
43.282
```

```
stats.norm.interval(alpha=0.95,    # Confidence level
                    loc=sample_mean,
                    scale=pop_stdev/math.sqrt(sample_size))  # Scaling factor
```

```
(42.46206406882683, 44.101935931173166)
```

T-distribution

```
#SD is unknown
sample_size = 25
sample = np.random.choice(a= population_ages, size = sample_size) #
sample_mean = sample.mean()

t_critical = stats.t.ppf(q = 0.975, df=24)  # Get the t-critical value*  df=n-1

print("t-critical value:")                  # Check the t-critical value
print(t_critical)

sample_stdev = sample.std()    # Get the sample standard deviation
sigma = sample_stdev/math.sqrt(sample_size)  # Standard deviation estimate     MG= t*SIGMA/S
margin_of_error = t_critical * sigma

confidence_interval = (sample_mean - margin_of_error,sample_mean + margin_of_error)

print("Confidence interval:")
print(confidence_interval)
```

```
t-critical value:
2.0638985616280205
Confidence interval:
(37.659096531075285, 47.46090346892472)
```

```
# Check the difference between critical values with a sample size of 1000

stats.t.ppf(q=0.975, df= 999) - stats.norm.ppf(0.975)
```

```
0.0023774765933946007
```

```
stats.t.interval(alpha = 0.95,              # Confidence level
                 df= 24,                    # Degrees of freedom
                 loc = sample_mean,         # Sample mean
                 scale = sigma)             # Standard deviation estimate
```

```
(37.659096531075285, 47.46090346892472)
```

Confidence interval using Proportions

```
#hispanic proportion estimate:                                      #z dist or normal dist
z_critical = stats.norm.ppf(0.975)      # Record z-critical value

p = 0.192                               # Point estimate of sample proportion

n = 1000                                # Sample size

margin_of_error = z_critical * math.sqrt((p*(1-p))/n)
```

```
confidence_interval = (p - margin_of_error,  p + margin_of_error)

confidence_interval
```

```
(0.16758794241348748, 0.21641205758651252)
```

```
stats.norm.interval(alpha = 0.95,    # Confidence level
                   loc =  0.192,     # Point estimate of proportion
                   scale = math.sqrt((p*(1-p))/n))  # Scaling factor
```

```
(0.16758794241348748, 0.21641205758651252)
```