EXPERIMENT 11

Aim:

To demonstrate the Central Limit Theorem (CLT) using sampling distributions of different sample sizes.

Algorithm:

1. Import the necessary libraries — NumPy and Matplotlib.
2. Generate a population following a normal distribution with a given mean and standard deviation.
3. Define multiple sample sizes (e.g., 30, 50, 100).
4. For each sample size, draw multiple random samples from the population and compute their means.
5. Plot histograms of the sample means for each sample size.
6. Compare them with the population mean to observe the Central Limit Theorem.

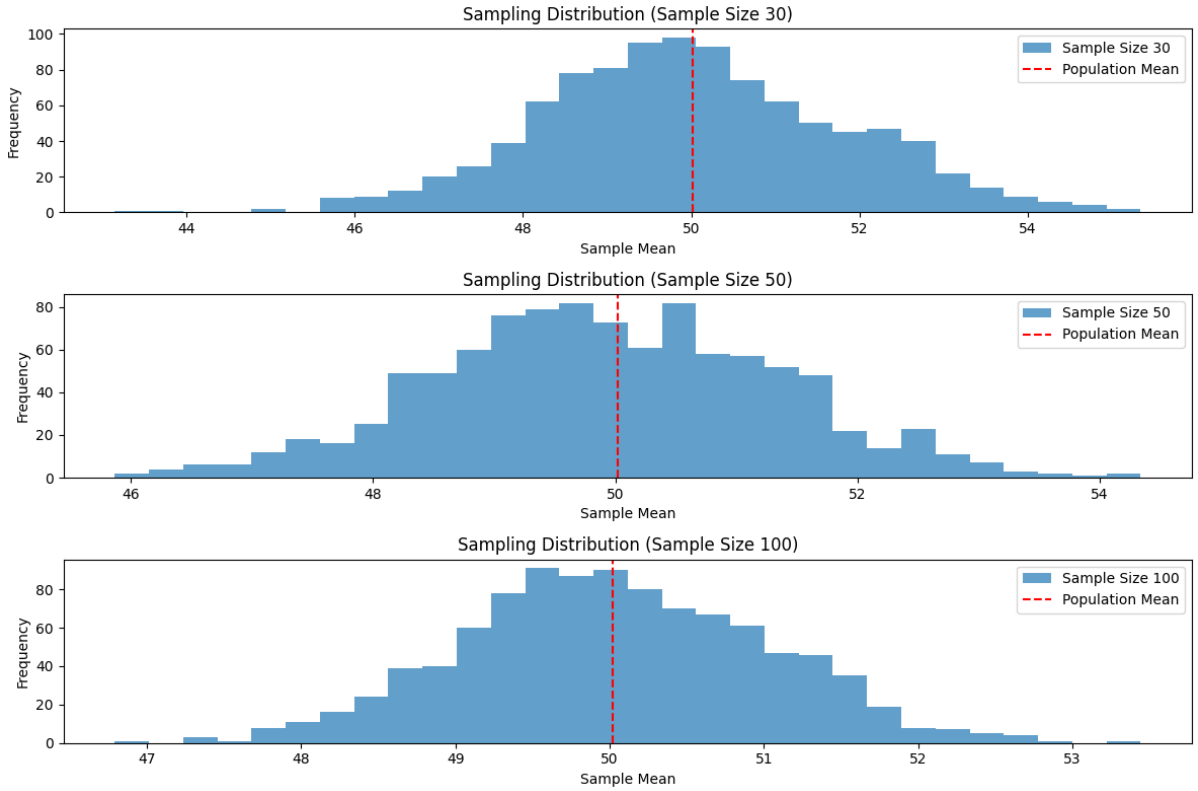
Code:

```
import numpy as np

import matplotlib.pyplot as plt


population_mean = 50

population_std = 10

population_size = 100000

population = np.random.normal(population_mean, population_std, population_size)


sample_sizes = [30, 50, 100]

num_samples = 1000

sample_means = {}


for size in sample_sizes:

  sample_means[size] = []

  for _ in range(num_samples):

    sample = np.random.choice(population, size=size, replace=False)
```

```
    sample_means[size].append(np.mean(sample))
```

```
plt.figure(figsize=(12, 8))
for i, size in enumerate(sample_sizes):
    plt.subplot(len(sample_sizes), 1, i+1)
    plt.hist(sample_means[size], bins=30, alpha=0.7, label=f'Sample Size {size}')
    plt.axvline(np.mean(population), color='red', linestyle='dashed', linewidth=1.5, label='Population Mean')
    plt.title(f'Sampling Distribution (Sample Size {size})')
    plt.xlabel('Sample Mean')
    plt.ylabel('Frequency')
    plt.legend()
plt.tight_layout()
plt.show()
```

Output:



Result:

The Central Limit Theorem was successfully demonstrated — as the sample size increases, the sampling distribution of the mean approaches a normal distribution centered around the population mean.