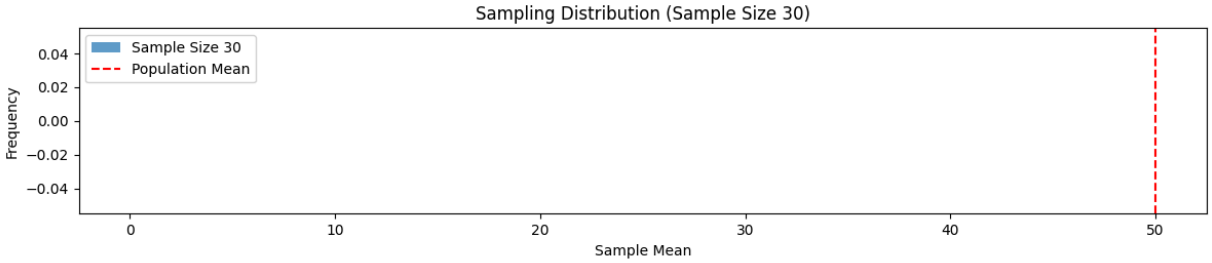
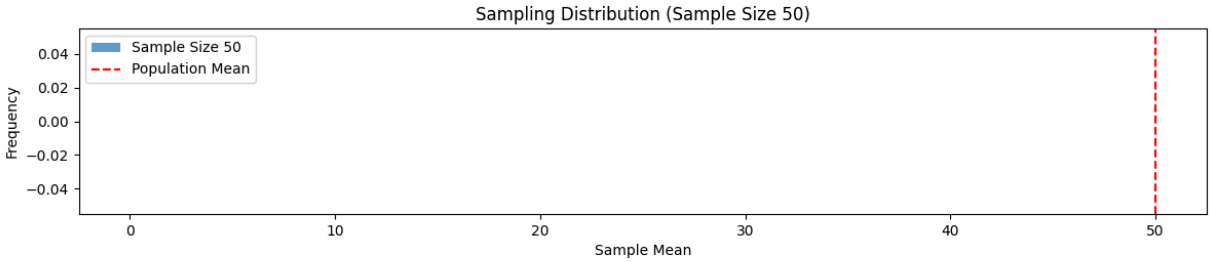
In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
```

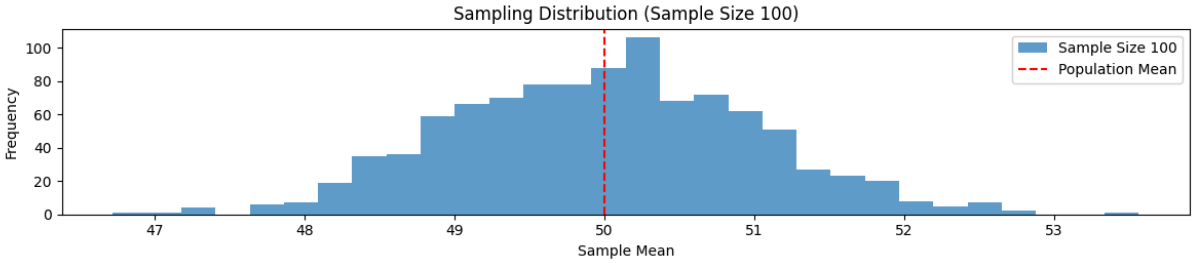
In [2]:
```
# Step 1: Generate a population (e.g., normal distribution)
population_mean = 50
population_std = 10
population_size = 100000
population = np.random.normal(population_mean, population_std, population_size)
```

In [3]:
```
# Step 2: Random sampling
sample_sizes = [30, 50, 100] # different sample sizes to consider
num_samples = 1000 # number of samples for each sample size
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))
```

In [4]:
```
# Step 3: Plotting sampling distributions
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
    plt.title(f'Sampling Distribution (Sample Size {size})')
    plt.xlabel('Sample Mean')
    plt.ylabel('Frequency')
    plt.legend()

plt.tight_layout()
plt.show()
```


Sampling Distribution (Sample Size 30)
Sample Size 30
Population Mean
Frequency
0.04
0.02
0.00
−0.02
−0.04
0
10
20
30
40
50
Sample Mean


Sampling Distribution (Sample Size 50)
Sample Size 50
Population Mean
Frequency
0.04
0.02
0.00
−0.02
−0.04
0
10
20
30
40
50
Sample Mean


Sampling Distribution (Sample Size 100)
Sample Size 100
Population Mean
Frequency
100
80
60
40
20
0
47
48
49
50
51
52
53
Sample Mean