```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import scipy.stats as stats
```

sampling distribution

```
mean_battery_life = 60
std_dev = 6
sample_size = 40
sample_mean = 58


std_error = std_dev / np.sqrt(sample_size)


z_score = (sample_mean - mean_battery_life) / std_error

# Probability (P(X < 58))
probability = stats.norm.cdf(z_score)


print(f"Z-score: {z_score}")
print(f"Probability that the mean lifetime is less than 58 months: {probability}")
```

```
Z-score: -2.1081851067789197
Probability that the mean lifetime is less than 58 months: 0.017507490509831244
```

Interval Estimation

```
# Given data
sample_mean = 310
std_dev = 89
sample_size = 40
confidence_level = 0.95

std_error = std_dev / np.sqrt(sample_size)

z_critical = stats.norm.ppf((1 + confidence_level) / 2)

margin_of_error = z_critical * std_error

confidence_interval = (sample_mean - margin_of_error, sample_mean + margin_of_error)

print(f"Z-critical value: {z_critical}")
print(f"Margin of error: {margin_of_error}")
print(f"95% confidence interval for the mean usage: {confidence_interval}")
```

```
Z-critical value: 1.959963984540054
Margin of error: 27.58087893755299
95% confidence interval for the mean usage: (282.419121062447, 337.580878937553)
```

Q3. Hypothesis Testing (Chinese Restaurant)

```
previous_mean = 4.5
sample_mean =5.0
std_dev = 1.0
sample_size = 50
alpha = 0.05

std_error = std_dev / np.sqrt(sample_size)

t_statistic = (sample_mean - previous_mean) / std_error

p_value = 2 * stats.t.sf(np.abs(t_statistic), df=sample_size-1)
```

```
p_value = 2 * stats.t.sf(np.abs(t_statistic), df=sample_size-1)

print(f"T-statistic: {t_statistic}")
print(f"P-value: {p_value}")

if p_value < alpha:
    print("Reject the null hypothesis: There is evidence that the mean waiting time has changed.")
else:
    print("Fail to reject the null hypothesis: No evidence that the mean waiting time has changed.")
```

```
T-statistic: 3.5355339059327378
P-value: 0.0009000029669488137
Reject the null hypothesis: There is evidence that the mean waiting time has changed.
```

Q4. P-value Calculation for Z-test

```
z_statistic = 2.00

# Two-tailed p-value
p_value = 2 * stats.norm.sf(np.abs(z_statistic))

print(f"Z-statistic: {z_statistic}")
print(f"P-value for the two-tailed test: {p_value}")
```

```
Z-statistic: 2.0
P-value for the two-tailed test: 0.04550026389635839
```

Q5. Hypothesis Testing for Samy (Income)

```
sample_mean = 30000
population_mean = 29000
std_dev = 8000
sample_size = 400
alpha = 0.05

std_error = std_dev / np.sqrt(sample_size)

z_statistic = (sample_mean - population_mean) / std_error

# One-tailed p-value (right tail)
p_value = stats.norm.sf(z_statistic)

print(f"Z-statistic: {z_statistic}")
print(f"P-value: {p_value}")

if p_value < alpha:
    print("Reject the null hypothesis: The mean household income is greater than 29,000 rupees.")
else:
    print("Fail to reject the null hypothesis: No evidence that the mean household income is greater than 29,000 rupees.")
```

```
Z-statistic: 2.5
P-value: 0.006209665325776132
Reject the null hypothesis: The mean household income is greater than 29,000 rupees.
```