```
import numpy as np
from scipy.stats import norm
from math import sqrt
```

Q1. Suppose an automobile battery manufacturer claims that the mean lifetime of their battery is 60 months with a standard deviation of 6 months. Suppose the distribution of battery life is approximately normal. Find the probability that the mean lifetime of 40 randomly sampled batteries will be less than 58 months.

```
# Question 1: Probability of the mean lifetime of batteries being less than 58 months
# Given data
mean_lifetime = 60  # months
std_dev = 6  # months
sample_size = 40
sample_mean = 58


# Standard error
std_error = std_dev / sqrt(sample_size)


# Z-score calculation
z_score_q1 = (sample_mean - mean_lifetime) / std_error


# Probability calculation
prob_q1 = norm.cdf(z_score_q1)



print(f"Q1: The probability that the mean lifetime is less than 58 months is {prob_q1:.4f}")
```

```
Q1: The probability that the mean lifetime is less than 58 months is 0.0175
```

Q2. A random sample of 40 households was selected as part of a study on electricity usage, and the number of kilowatt-hours (kWh) was recorded for each household in the sample for the first quarter of 2020. The average usage was found to be 310 kWh. In a very large study in the first quarter of the previous year, it was found that the standard deviation of the usage was 89 kWh.

Assuming the standard deviation is unchanged and that the usage is normally distributed, provide an expression for calculating a 95% confidence interval for the mean usage in the first quarter of 2019.

```
# Question 2: 95% confidence interval for the mean usage in Q1 2019
# Given data
sample_mean_q2 = 310  # kWh
std_dev_q2 = 89  # kWh
sample_size_q2 = 40
confidence_level = 0.95


# Standard error
std_error_q2 = std_dev_q2 / sqrt(sample_size_q2)



# Z-value for 95% confidence
z_value = norm.ppf(1 - (1 - confidence_level) / 2)


# Confidence interval
lower_bound = sample_mean_q2 - z_value * std_error_q2
upper_bound = sample_mean_q2 + z_value * std_error_q2


print(f"Q2: The 95% confidence interval for mean usage is ({lower_bound:.2f}, {upper_bound:.2f}) kWh")
```

```
Q2: The 95% confidence interval for mean usage is (282.42, 337.58) kWh
```

Q3. You are a manager of a Chinese restaurant. You want to determine whether the mean waiting time to place an order has changed in the past month from its previous population mean value of

://colab.research.google.com/drive/1IYB72bWdw3_DQtzpU6i6dZM2WuQpNiJg?authuser=6#scrollTo=XeV1U7GkVNZY&printMode=true

24, 12:23 AM Copy of Practice_Exercise_Estimation_Hypothesis_Solutions.ipynb - Colab

4.5 minutes. State the null and alternative hypotheses.

```
# Question 3: Hypothesis testing for mean waiting time
# Null Hypothesis (H0): Mean waiting time = 4.5 minutes
# Alternative Hypothesis (Ha): Mean waiting time ≠ 4.5 minutes

print("Q3: Null hypothesis (H0): Mean waiting time = 4.5 minutes")
print("Alternative hypothesis (Ha): Mean waiting time ≠ 4.5 minutes")
```

```
Q3: Null hypothesis (H0): Mean waiting time = 4.5 minutes
Alternative hypothesis (Ha): Mean waiting time ≠ 4.5 minutes
```

Q4. What is the p-value in a two-tailed z-test for one sample, where the computed test statistic (z-stat) is equal to +2.00?

```
# Question 4: P-value for a two-tailed z-test
z_stat_q4 = 2.007


# P-value calculation
p_value_q4 = 2 * (1 - norm.cdf(abs(z_stat_q4)))


print(f"Q4: The p-value for the two-tailed z-test is {p_value_q4:.4f}")
```

```
Q4: The p-value for the two-tailed z-test is 0.0447
```

Q5. Samy, Product Manager of K2 Jeans, wants to launch a product line into a new market area. A Survey of a random sample of 400 households in that market showed a mean income per household of 30000 rupees. The standard deviation based on an earlier pilot study of households is 8000 rupees. Samy strongly believes the product line will be adequately profitable only in markets where the mean household income is greater than 29000 rupees. Samy wants our help in deciding whether the product line should be introduced in the new market. Perform statistical analysis and based on that draw a conclusion.

Assume a level of significance (α) of 5%

```
# Question 5: Statistical analysis for mean household income
# Given data
sample_mean_q5 = 30000  # rupees
population_mean_q5 = 29000  # rupees
std_dev_q5 = 8000  # rupees
sample_size_q5 = 400
alpha = 0.05


# Standard error
std_error_q5 = std_dev_q5 / sqrt(sample_size_q5)


# Z-score calculation
z_score_q5 = (sample_mean_q5 - population_mean_q5) / std_error_q5



# P-value calculation
p_value_q5 = 1 - norm.cdf(z_score_q5)



print(f"Q5: Z-score for the test is {z_score_q5:.4f}")
print(f"Q5: P-value for the one-tailed test is {p_value_q5:.4f}")
```

```
Q5: Z-score for the test is 2.5000
Q5: P-value for the one-tailed test is 0.0062
```

```
# Conclusion
if p_value_q5 < alpha:
    print("Q5: Reject the null hypothesis. The product line should be introduced.")
else:
    print("Q5: Fail to reject the null hypothesis. The product line should not be introduced.")
```

```
Q5: Reject the null hypothesis. The product line should be introduced.
```

Start coding or generate with AI.

Start coding or generate with AI.