Case Study 1: IoT Temperature Monitoring System Accuracy

Case Study Preamble

A chemical manufacturing plant relies on an IoT-based temperature monitoring system to maintain safe storage conditions for temperature-sensitive materials.

Under normal operation, the system is calibrated so that the **average temperature reading is 25°C**. Following a recent firmware update intended to improve sensor responsiveness, engineers became concerned that changes in signal processing might have unintentionally affected the accuracy of the temperature readings.

Because both **overestimation and underestimation** of temperature could pose safety risks, the engineers need to determine whether the update has changed the system's average temperature measurement.

Sample Data (°C)

Thirty temperature readings recorded after the update were randomly selected:

24.1, 25.3, 23.9, 24.7, 25.0,
24.4, 26.1, 24.8, 23.7, 24.9,
25.2, 24.5, 23.8, 24.6, 25.1,
24.0, 26.0, 24.3, 24.9, 25.4,
23.6, 24.7, 25.0, 24.2, 24.8,
25.3, 24.1, 23.9, 24.6, 25.1

Questions

1. Identify the **population parameter of interest**.
2. State the **null hypothesis (H_o)** and **alternative hypothesis (H_1)**.
3. Specify the **appropriate significance level (α)**.
4. Calculate the **sample mean**.
5. Calculate the **sample standard deviation**.
6. Determine whether a **z-test or t-test** should be used, and justify your choice.

Case Study 2: IoT Water Leak Detection Response Time

Case Study Preamble

A commercial office building uses an IoT-based water leak detection system to minimize water damage by quickly identifying leaks and alerting maintenance personnel.

The existing system has a known average response time of **90 seconds**, which serves as the performance benchmark.

To improve detection speed, a new **edge-computing algorithm** was implemented, allowing sensor data to be processed locally rather than relying entirely on cloud servers. The primary objective of this update is to **reduce the response time**.

After deploying the new algorithm, the facilities management team collected system performance data over several days. From this dataset, **25 leak detection events** were randomly selected for analysis.

Sample Data (seconds)

82, 88, 79, 85, 90,
84, 86, 81, 83, 87,
78, 85, 80, 82, 88,
84, 86, 79, 81, 83,
85, 82, 84, 80, 86

Questions

1. Identify the **population parameter of interest**.
2. Formulate the **null hypothesis (H_o)** and **alternative hypothesis (H_1)**.
3. Explain **why this is a one-tailed test**.
4. Choose an appropriate **significance level (α)**.
5. Calculate the **sample mean** and **sample standard deviation**.
6. Decide whether a **z-test or t-test** is appropriate and justify your choice.
7. Compute the **test statistic**.
8. Determine the **critical value** and make a **decision about H_o**.