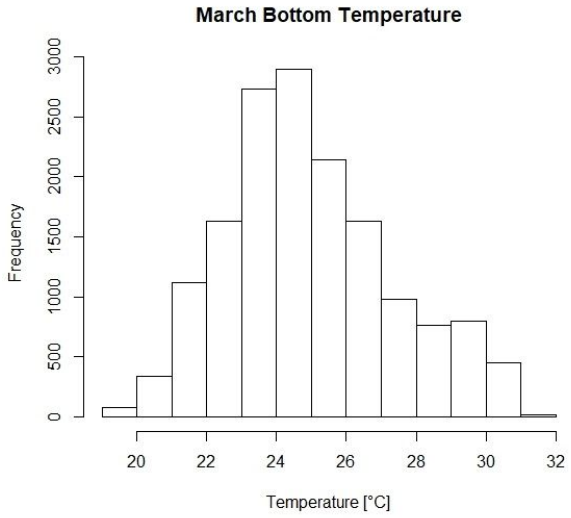
The Empirical Rule & Z-Scores Worksheet (Answer Key)

KEY TERMS

- **Empirical Rule**: *a rough guideline for the approximate percentage of data within one to three standard deviations of the mean in symmetric, unimodal distributions*
  - Guidelines:
    - 68% of data is within one standard deviation
    - 95% of data is within two standard deviations (beyond this is "unusual")
    - 99.7% of data is within three standard deviations

- **z-score:** *a number that measures the number of standard deviations an observed data value is from the mean*
  - $z = (x - \bar{x}) \div s$

Gould, R., & Ryan, C. N. (2015). Introductory statistics: Exploring the world through data. Pearson.

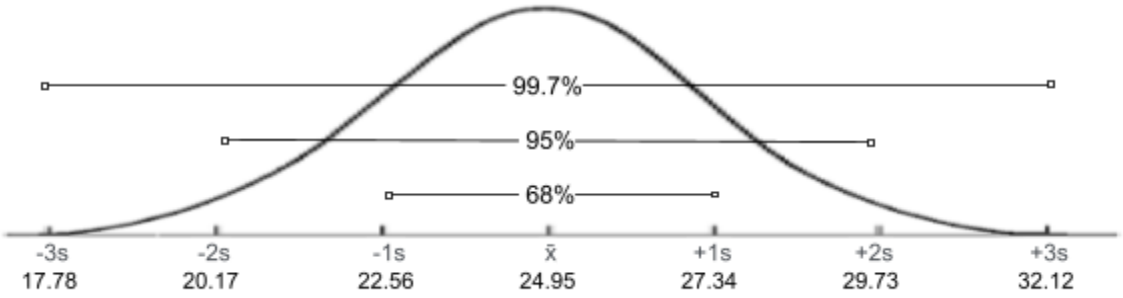


Here is a histogram of bottom temperature data from the Mokauea loko i'a from March 2020. This data has been cleaned where duplicates and outliers have been removed.

Temperature is a critical parameter that needs to be understood to perform restoration efforts to the Mokaeua loko i'a. Help us to understand March 2020's temperature by completing the exercises below.

EXERCISE 1: The Empirical Rule

The March 2020 Mokauea loko i'a data has a mean of 24.95°C and a standard deviation of 2.39°C. Apply the Empirical Rule to this data by drawing a labeled picture of the distribution.



The above data is real data collected from research at Mokauea loko i'a.
Additional Mokauea loko i`a data can be explored here: http://grogdata.soest.hawaii.edu/

Based on your drawing above, is 31°C considered unusual? Explain your answer.
31°C would be considered unusual because it falls beyond 2 standard deviations. Any value that falls below -2 standard deviations, or above 2 standard deviations is considered unusual.

EXERCISE 2: z-score

With the same information provided in Exercise 1, calculate the z-score for the temperature of 21°C. Round to the nearest hundredth.

$z = (x - \bar{x}) \div s = (21 - 24.95) \div 2.39 \approx -1.65$

Calculate the z-score for the temperature of 30.5°C. Round to the nearest hundredth.

$z = (x - \bar{x}) \div s = (30.5 - 24.95) \div 2.39 \approx 2.32$

Calculate the z-score for the temperature of 25°C. Round to the nearest hundredth.

$z = (x - \bar{x}) \div s = (25 - 24.95) \div 2.39 \approx 0.02$

Check: Do your calculated z-score answers make sense based on your drawing in Exercise 1?