

Does your tablespoon conform to the US Standard?

In order to discover if a tablespoon conforms to US standards, it is necessary to experiment. To test a certain tablespoon, an experimenter used a burette to measure the amount of water required to fill a tablespoon. This procedure was repeated 10 times, and data was tabulated. (Figure 1)

To declare outright whether or not the tablespoon conforms to standards, one must use statistics to make a statement about error. In this case, error was determined to be from human error, in this case measuring the liquid incorrectly. Another source of human error is the inability to completely and precisely fill the tablespoon with liquid. Because of error, one cannot simply take the average of the data. Using logger-pro, it was possible to calculate the standard deviation, along with other statistics, automatically. (Figure 2) Using the formula:

$$\text{standard error} = \frac{\sigma}{\sqrt{n}}$$

it was possible to find the standard error, a measurement used to allow for error in the reporting of data. In this case, the mean of the dataset was 14.66 mL. This meant that with a standard error of 0.04711 mL, the appropriate amount of liquid held by the tablespoon is:

$$14.66 \text{ mL} \pm 0.04711 \text{ mL}$$

The US Standard for a tablespoon given in milliliters is 14.8 mL. At its maximum error, the actual tablespoon held 14.71 mL, which caused it to fall short of the standard. In this case, it was proven that the tablespoon did not conform to US standards.

| Event | Volume (mL) |
|-------|----------------|
| 1 | 14.89 |
| 2 | 14.65 |
| 3 | 14.71 |
| 4 | 14.59 |
| 5 | 14.92 |
| 6 | 14.7 |
| 7 | 14.46 |
| 8 | 14.55 |
| 9 | 14.54 |
| 10 | 14.6 |

Figure 1

Statistics for: Data Set | Volume
min: 14.46 at 7.000 max: 14.92 at 5.000
mean: 14.66 median: 14.63
std. dev: 0.1490 samples: 10
 ΔV : 0.46

Figure 2