

Critical Work Function: Perform mathematical manipulations

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| Key Activities | Perform data analysis Perform calculations relating to work function |
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Title: Statistical analysis of laboratory data**Assessment:**

Students should be comfortable performing statistical analyses that pertain to data sets commonly encountered within bioscience laboratories. In particular, students should be able to calculate accuracy (i.e. absolute error and % error) and precision (i.e. standard deviation). Any time students repeat a measurement, accuracy and precision can be calculated. Students should also observe the correct number of significant figures.

Example

You are verifying the performance of a balance in your lab. You weigh the same 10g standard four times and obtain the weights below. Calculate the accuracy and precision of the balance. (*Note: While this example uses four measurements, this exercise is best done using ten or more measurements.*)

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| 10.001g | 9.999g |
| 9.998g | 10.005g |

Answer

Accuracy can be calculated using the following equation:

$$\% \text{ error} = \frac{\text{calculated mean} - \text{expected value}}{\text{expected value}} \times 100\%$$

To solve this equation, the student must first calculate the data set's mean (\bar{x}).

$$\text{mean} = \bar{x} = \frac{\text{sum of data points}}{\text{total number of data points}} = \frac{40.003}{4} = 10.001$$

$$\% \text{ error} = \frac{10.001 - 10.000}{10.000} \times 100\% = \mathbf{0.01\%}$$

Precision is calculated using the following formula, which also requires a calculation of the mean (i.e. \bar{x}):

$$\text{Standard Deviation (SD)} = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$$

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$$SD = \sqrt{\frac{\Sigma(10.001 - 10.001)^2 + (9.999 - 10.001)^2 + (9.998 - 10.001)^2 + (10.005 - 10.001)^2}{4 - 1}} = \mathbf{0.003}$$

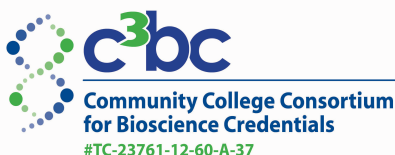
where n is the number of measurements.

Note that both the answer for accuracy and precision contain the correct number of significant figures. Because the Standard Deviation is a small number, students could be asked to express this value in scientific notation:

$$SD = 0.003 = 3 \times 10^{-3}$$

Resources for teaching:

- Seidman, L.A., and C.J. Moore. 2009. Basic Laboratory Methods for Biotechnology Pearson Education, Inc., San Francisco, CA.
- Seidman, L.A., M.E. Kraus, D.L. Brandner, J. Mowery. 2011. Laboratory Manual for Biotechnology and Laboratory Science Pearson Education, Inc., San Francisco, CA.



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