Error Analysis

Calculate the percent error, the average deviation from the mean, and the average deviation of the mean, the variance, the standard deviation, and the standard deviation of the mean for the following sets of data.

Example: The theoretical value of a set of data is 9.8 and the experiments produced results of 9.2, 9.7, 9.6, 9.9, 9.8, and 10.0.

To calculate <u>percent error,</u> first find the average of the experiments. Then use the percent error equation.

$$Average\ Experimental\ Value = \frac{9.2 + 9.7 + 9.6 + 9.9 + 9.8 + 10.0}{6} = 9.7$$

$$Percent\ Error = \left|\frac{9.8 - 9.7}{9.8}\right| x\ 100\% = 1.02\%$$

To calculate **average deviation from the mean ($D_{\bar{x}}$)** first find the average of the experiments. Then use the experimental average to find the absolute deviation of each measurement. Finally average the deviations.

Experimental Value	Equation	Deviation	Deviations Squared
9.2	|9.2-9.7|	0.5	0.25
9.7	|9.7-9.7|	0.0	0.00
9.6	|9.6-9.7|	0.1	0.01
9.9	|9.9-9.7|	0.2	0.04
9.8	|9.8-9.7|	0.1	0.01
10.0	|10.0-9.7|	0.3	0.09
Average 9.7		$D_{\bar{x}} = 0.2$	$s^2 = 0.10$

The Average Deviation from the mean $(D_{\bar{x}}) = 9.7 \pm 0.2$

To calculate **average deviation of the mean (A.D.),** first find the average deviation from the mean ($D_{\bar{x}}$) then take that value and divide that value by the square root of the of the number of trials.

The Average Deviation of the mean (A.D.) $= 9.7 \pm \frac{0.2}{\sqrt{6}} = 9.7 \pm 0.08$

To calculate the **variance σ^2** of a **Sample** first find the deviations from each number (D_i) then square each deviation. Finally take the sum of the squared deviations and divide by one less than the number of measurements.

The variance $(s^2) = 0.10$

The "**Standard Deviation" from the mean** (σ) is the square root of the variance.

$(s) = \sqrt{(s^2)} = 0.32$

The **Standard Deviation of the mean** ($s_{\bar{x}}$) is s divided by the square root of the number of measurements.

$(\sigma_{\bar{x}}) = \frac{\sigma}{\sqrt{N}} = \frac{0.32}{\sqrt{6}} = 0.14$

1. T= 25.0
   E=26.0 , 28.0, 24.0, 27.0, 23.0, 20.0

Percent Error= _____

$D_{\bar{x}} =$ _____

A.D.= _____

$(s^2) =$ _____

$(s) =$ _____

$(s_{\bar{x}}) =$ _____

2. T=100.0
   E=85.0, 67.0, 93.0, 97.0, 75.0

Percent Error= _____

$D_{\bar{x}} =$ _____

A.D.= _____

$(s^2) =$ _____

$(s) =$ _____

$(s_{\bar{x}}) =$ _____

3. E=4.37, 5.62, 4.91, 4.75, 5.25, 5.44
   T=5.00

Percent Error=

$D_{\bar{x}} =$

A.D.=

$(s^2) =$

$(s) =$

$(s_{\bar{x}}) =$

4. E=8.86, 7.35, 9.62, 9.20, 8.80
   T=12.00

Percent Error=

$D_{\bar{x}} =$

A.D.=

$(s^2) =$

$(s) =$

$(s_{\bar{x}}) =$

5. E=9.75, 13.25, 8.63, 15.1, 16.7
    T=12.5

Percent Error= _____

$D_{\bar{x}} =$ _____

A.D.= _____

$(s^2) =$ _____

$(s) =$ _____

$(s_{\bar{x}}) =$ _____

6. T=15.5
    E=15.0, 17.0, 20.0, 15.0, 15.0, 15.0

Percent Error= _____

$D_{\bar{x}} =$ _____

A.D.= _____

$(s^2) =$ _____

$(s) =$ _____

$(s_{\bar{x}}) =$ _____