Measurement Error

Please do the following exercises individually.

Random Errors

The results of a measurement can be found in the table below:

9.97	9.87	10.02	10.13	10.12	10.17	9.78	9.98	10.11	9.89

Please determine the mean, the median and the standard deviation of the collected data. Specify the range in which 95% of all measuring values are expected.

Error Propagation

Please solve the examples of error propagation presented in the script without using the solution.

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$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{9.97 + 9.87 + \cdots + 10.11 + 9.89}{10} = 10.004$$

n	1	2	3	4	5	6	7	8	9	10
value	9.78	9.87	9.89	9.97	9.98	10.02	10.11	10.12	10.13	10.17

$$\bar{x}_{med} = \frac{x_{\left(\frac{n}{2}\right)} + x_{\left(\frac{n}{2}+1\right)}}{2} = \frac{9.98 + 10.02}{2} = 10.000$$

x_i	9.97	9.87	10.02	10.13	10.12	10.17	9.78	9.98	10.11	9.89
d_i	-0.034	-0.134	0.016	0.126	0.116	0.166	-0.224	-0.024	0.106	-0.114

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} d_i^2}{n-1}} = \sqrt{\frac{-0.034^2 + \cdots + -0.114^2}{9}} = 0.130$$

It is expected that 95% of all measuring values are in the range $[\bar{x} - 2\sigma, \bar{x} + 2\sigma\,] = 10.00 \pm 0.26$.

Error Propagation

Please solve the examples of error propagation presented in the script without using the solution.

There is an example for the propagation of systematic errors and an example for the propagation of random errors in the script. Please refer to the script for the solution.