

Experimental Uncertainty (Error) and Data Analysis

Advance Study Assignment

1. Do experimental measurements give the true value of a physical quantity?

Explain.

The experimental measure does not give the exact true value of a physical quantity. It can not be 100% accurate. There are plenty of errors that might have a value such as personal bias, systematic instrumental and accidental errors. Experimental measurements are often close to the real value.

2. Distinguish between random statistical error and systematic error and give an example of each.

Systematic error is constant and affects accuracy; it will stay the same no matter how many trials. Random error is something that will change and is random on every trial and is unpredictable and affects precision. An example of a systematic error is like an error on a ruler and how it may be longer or shorter in length that error is constant in length and will not change. While a random error is like shooting a cannon, its position will not be the same when it lands on the ground.

3. What is the difference between determinate and indeterminate errors?

A determinant error is an error that is known and can be calculated for. While an indeterminate error is unknown and can ruin the experiment's accuracy. Determinate errors are systematic errors that are consistent and predictable. Indeterminate errors are random fluctuations or uncertainties in measurements that occur unpredictably and inconsistently.

4. What is the difference between measurement accuracy and precision? Explain their general dependence on the various types of errors.

Precision measures the consistency and reproducibility of measurements. It limits how many sig figs that can be made. While measuring accuracy, measuring a quantity and comparing its value

to its true or accepted value.. Errors like systematic are constant and having better precision would make it more accurate, while random errors are random and better measurement accuracy should help them to be more accurate.

5. What determines the number of significant figures in reporting measurement values? What would be the effect of reporting more or fewer figures or digits than are significant?

The amount of sig figs is determined by how accurate the experiment was measured. Having more sig figs than the precision would give the result of seeming more accurate. While less would report a worse result.

6. In expressing experimental error or uncertainty, when does one use (a) experimental error and (b) percent difference?

- (a) Experimental error is comparing the free value vs the experimental value that was obtained. It is usually used to determine the accuracy of the experiment.
- (b) Percent difference is determining the difference between two experiments. It is used to compare the results of two different experiments.

7. For a series of experimentally measured values distinguished among (a) The average or mean value, (b) the deviation from the mean and (c) the mean deviation.

- (a) The meaning is adding up all the numbers and dividing them up by another number. It represents the typical values of a set of numbers.
- (b) It is the difference between what is the difference from each individual data point and the mean of the dataset.
- (c) It is the average deviation of data points from the mean of the dataset.

8. What is the statistical significance of one standard deviation? Two standard deviations?

The statistical significance of one standard deviation is usually 68% of the data while two standard deviations is 95% of the data falls.

Question: Based on the results of your experiment, how many shots should you take if you want to measure the mean range of the gun to within 2 mm of it's true value, with a 95% probability of being right?