

Systematic Error ^[1]

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Systematic error is a type of error that deviates by a fixed amount from the true value of measurement.

As opposed to random errors, systematic errors are easier to correct. There are many types of systematic errors and a researcher needs to be aware of these in order to offset their influence.

Systematic error in physical sciences commonly occurs with the measuring instrument having a zero error. A zero error is when the initial value shown by the measuring instrument is a non-zero value when it should be zero.

For example, a voltmeter might show a reading of 1 volt even when it is disconnected from any electromagnetic influence. This means the systematic error is 1 volt and all measurements shown by this voltmeter will be a volt higher than the true value.

This type of error can be offset by simply deducing the value of the zero error. In this case, if the voltmeter shows a reading of 53 volt, then the actual value would be 52 volt. In this case, the systematic error is a constant value.

Sometime the measuring instrument itself is faulty, which leads to a systematic error. For example, if your stopwatch shows 100 seconds for an actual time of 99 seconds, everything you measure with this stopwatch will be dilated, and a systematic error is induced in your measurements. In this case, the systematic error is proportional to the measurement.

In many experiments, there are inherent systematic errors in the experiment itself, which means even if all the instruments were 100% perfect there would still be an error.

For example, in an experiment to calculate acceleration due to gravity using the length and time period of a simple pendulum, the size of the pendulum bob, the air friction, the slight movement of support, etc. all affect the calculated value. These systematic errors are inherent to the experiment and need to be accounted for in an approximate manner.

Many systematic errors cannot be gotten rid of by simply taking a large number of readings and averaging them out.

For example, in the case of our faulty voltmeter, even if a hundred readings are taken, they will all be near 53 volt instead of the actual 52 volt.

Therefore in such cases, calibration of the measuring instrument prior to starting the experiment is required, which will reveal if there is any systematic error or zero error in the measuring instrument.

Systematic errors ^[3] can also be produced by faulty human observations or changes in environment during the experiment, which are difficult to get rid of.

Source URL: <https://explorable.com/systematic-error>

Links

[1] <https://explorable.com/systematic-error>

[2] <https://explorable.com/users/siddharth>

[3] http://en.wikipedia.org/wiki/Systematic_error