TYPES OFERRORS IN MESUREMENT

Divakar Gupta, Kamal Chhetri, Virender Gupta
Electrical And ElectronicsDronacharya College Of Engineering, Gurgaon

***Abstract*- This paper describes types of errors which are commonly occurred in measurement. Error in the measurement of a physical quantity is its deviation from actual value. In this paper we have mention some of the types of errors that cause uncertainty is an experimental in measurement. First, there can always be those gross blunders in apparatus or instrument construction which may invalidate the data. Second, there may be certain fixed errors which will cause repeated readings to be in error by roughly some amount but for some unknown reasons. These are sometimes called systematic errors. Third, there are the random errors, which may be caused by personal fluctuation, random electronic fluctuation in apparatus or instruments, various influences of friction, etc.**

I. INTRODUCTION

The measurement of a quantity is based on some International fundamental standards.
These fundamental standards are perfectly accurate, while others are derived from these.
These derived standards are not perfectly accurate in spite of all precautions. In general,
measurement of any quantity is done by comparing with derived standards which
themselves are not perfectly accurate. So, the error in the measurement is not only due to
error in methods but also due to standards (derived) not being perfectly accurate. Thus,
the measurement with 100% accuracy is not possible with any method.
Error in the measurement of a physical quantity is its deviation from actual value.
If an experimenter knew the error, he or she would correct it and it would no longer be an
error. In other words, the real errors in experimental data are those factors that are always vague to some extent and carry some amount of uncertainty. A reasonable definition of experimental uncertainty may be taken as the possible value the error may
have. The uncertainty may vary a great deal depending upon the circumstances of the
experiment. Perhaps it is better to speak of experimental uncertainty instead of
experimental error because the magnitude of an error is uncertain.
At this point, we may mention some of the types of errors that cause uncertainty is an
experimental in measurement. First, there can always be those gross blunders in
apparatus or instrument construction which may invalidate the data. Second, there may
be certain fixed errors which will cause repeated readings to be in error by roughly some
amount but for some unknown reasons. These are sometimes called systematic errors.
Third, there are the random errors, which may be caused by personal fluctuation, random
electronic fluctuation in apparatus or instruments, various influences of friction, etc

II. ERRORS

The error in measurement is a mathematical way to show the uncertainty in the measurement. It is the difference between the result of the measurement and the true value of what you were measuring

2.2 TYPES OF ERROR

Errors will creep into all measurement regardless of the care which is exerted. But it is
important for the person performing the experiment to take proper care so that the error

can be minimized. Some of the errors are of random in nature, some will be due to gross blunder on the part of the experimenter and other will be due to the unknown reasons which are constant in nature.

Thus, we see that there are different sources of errors and generally errors are classified mainly into three categories as follows:

(a) Gross errors

(b) Systematic errors

(c) Random errors

2.2.1 GROSS ERRORS

These errors occur due to human mistakes in reading instruments and recording and calculating results of measurement. Although it is probably impossible to eliminate the gross error completely, yet one should try to anticipate and correct them. The mathematical analysis of gross errors is impossible since these may occur in different amounts. While some gross errors may be easily detected, others may go unnoticed.

2.2.2 SYSTEMATIC ERRORS

These are inherent errors of apparatus or method. These errors always give a constant deviation. On the basis of the sources of errors, systematic errors may be divided into following sub-categories:

2.2.2(a) CONSTRUCTIONAL ERROR

None ofthe apparatus can be constructed to satisfy all specifications completely.

This is the reason of giving guarantee within a limit. Therefore, a manufacturers always mention the minimum possible errors in the construction of the instruments.

2.2.2(b) ERRORS IN READING AND OBSERVATION

Following are some of the reasons of errors in results of the indicating instruments :

(a) Construction of the Scale

There is a possibility of error due to the division of the scale not being uniform and clear.

(b) Fitness and Straightness of the Pointer

If the pointer is not fine and straight, then it always gives the error in the reading.

(c) Parallax Without a mirror under the pointer there may be parallax error in reading.

(d) Efficiency or Skillness of the Observer :Error in the reading is largely dependent upon the skillness of the observer by which reading is noted accurately.

2.2.2(c) DETERMINATION ERROR

It is due to the indefiniteness in final adjustment of measuring apparatus. For example, Maxwell Bridge method of measuring inductances, it is difficult to find the differences in sound of head phones for small change in resistance at the time of final adjustment. The error varies from person to person.

2.2.2(d) ERRORS DUE TO OTHER FACTORS

TEMPERATURE VARIATION

Variation in temperature not only changes the values of the parameters but also brings changes in the reading of the instrument. For a consistent error, the temperature must be constant.

EFFECT OF THE TIME ON INSTRUMENTS

There is a possibility of change in calibration error in the instrument with time. This may be called ageing of the instrument.

MECHANICAL ERRORS

Friction between stationary and rotating parts and residual torsion in suspension wire cause errors in instruments. So, checking should be applied. Generally, these errors may be checked from time to time.

2.2.3 RANDOM ERRORS

After corrections have been applied for all the parameters whose influences are known, there is left a residue of deviation. These are random error and their magnitudes are not constant. Persons performing the experiment have no control over the origin of these errors. These errors are due to so many reasons such as noise and fatigue in the working persons. These errors may be either positive or negative. To these errors the law of probability may be applied. Generally, these errors may be minimized by taking average of a large number of readings.

III. ACCURACY AND PRECISION

the accuracy of a measurement system is the degree of closeness of measurements of a quantity to that quantity's actual (true) value.[1] The precision of a measurement system, related to reproducibility and repeatability, is the degree to which repeated measurements under unchanged conditions show the same results.[1][2] Although the two words precision and accuracy can besynonymous in colloquial use, they are deliberately contrasted in the context of the scientific method.

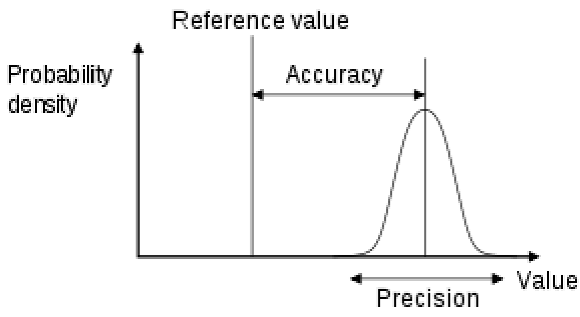
A measurement system can be accurate but not precise, precise but not accurate, neither, or both. For example, if an experiment contains a systematic error, then increasing the sample size generally increases precision but does not improve accuracy. The result would be a consistent yet inaccurate string of results from the flawed experiment. Eliminating the systematic error improves accuracy but does not change precision.

A measurement system is considered *valid* if it is both *accurate* and *precise*. Related terms include *bias* (non-random or directed effects caused by a factor or factors unrelated to the independent variable) and *error*(random variability).

The terminology is also applied to indirect measurements—that is, values obtained by a computational procedure from observed data.

In addition to accuracy and precision, measurements may also have a measurement resolution, which is the smallest change in the underlying physical quantity that produces a response in the measurement.

In numerical analysis, accuracy is also the nearness of a calculation to the true value; while precision is the resolution of the representation, typically defined by the number of decimal or binary digits.



IV. CALIBRATION OF THE INSTRUMENT

The calibration of the instrument is done to find its accuracy. Before using an instrument, particularly a new one, in a measurement system, it is required to calibrate it to find the accuracy, precision or uncertainty of the instrument. It can be done by comparing its performance with

(a) a primary standard instrument,

(b) a secondary standard instrument having high accuracy, and

(c) a known input source.

For example, a flowmeter might be calibrated by

(a) comparing it with a standard flow measurement facility of the National Bureau of Standards,

(b) comparing it with another flowmeter of known accuracy, or

(c) direct calibration with a primary measurements such as weighing a certain amount of water in a tank and recording the time elapased for the quantity of flow through the meter.

V. CONCLUSION

In this study we aimed to represent the types of errors which are normally occurred in measurments. If we have to take accurate readings then we must take care of above mentioned errors.

REFERENCES

[1] Nithya V. "Gross Errors" Session Name: Errors in Measurement System.

[2] Wikipedia "Accuracy & Precision"