STATISTICAL ANALYSIS OF MEASUREMENT DATA

REVIEW – CLASS-6

Errors in Measurement

CONTENT-CLASS-7

Review Answers for worksheet-6	Statistical Analysis of Measurement Data	Video Show- Tanjore Temple Secrets Part-1
Class work Problem	Summary	Worksheet-7

STATISTICAL ANALYSIS

- **Statistical methods are frequently used to find the most probable value from a group of readings taken from a given experiment.**

1. **Average or arithmetic mean value**
2. **Deviation from the average value**
3. **Average deviation**
4. **Standard deviation**
5. **Variance**
6. **Gaussian (normal) distribution of error**

AVERAGE OR ARITHMETIC MEAN

- Most probable value obtained from a series of readings of a given quantity.
- The more readings, the more closely the computed average values.

$$\bar{X} = \frac{\Sigma x_i}{n} = \frac{x_1 + x_2 + \ldots . x_n}{n}$$

where $\bar{X}$ is the average value or arithmetic mean

x_i is the value of the i^{th} reading

n is the number of readings

DEVIATION FROM THE AVERAGE VALUE

The deviation from the average value is a measure of how far each measured value departs from the average value. It may be either positive or negative. For a value x_i from a group of values having an average value $\bar{X}$, the deviation d of x_i is expressed as

$$d_i = x_i - \bar{X} \quad \ldots (1.40)$$

VIDEO SHOW

Tanjore Temple Secrets Part-1

https://www.youtube.com/watch?v=yySZCRgAX_g

AVERAGE DEVIATION

- Measure of how much the data is dispersed.
- Result is always positive number. Indicates the precision of the measurement.
- Not as useful as the standard deviation.

$$\bar{D} = \frac{|d_1| + |d_2| + ... + |d_n|}{n}$$

$$= \frac{\Sigma |d_i|}{n} \qquad \text{(where } i = 1 \text{ to } n\text{)}$$

STANDARD DEVIATION

- Also known as root mean square deviation.
- Mathematically more convenient and statistically more meaningful for analyzing grouped data.

$$s = \sqrt{\frac{\Sigma (\bar{X} - x_i)^2}{n}} = \sqrt{\frac{\Sigma d_i^2}{n}}$$

If number of observations are < 20,

$$s = \sqrt{\frac{\Sigma (\bar{X} - x_i)^2}{n - 1}}$$

VARIANCE

- It is the mean square deviation, which is the same as standard deviation, except the square root is not extracted.

$$V = (\text{Standard deviation})^2$$

$$= \frac{d_1^2 + d_2^2 + d_3^2 + ... + d_n^2}{n}$$

$$= \frac{\Sigma d^2}{n}$$

When, the number of observations is less than 20,

$$\text{Variance } V = \frac{\Sigma d^2}{n-1}$$

GAUSSIAN (NORMAL) DISTRIBUTION OF ERROR

- Graph a large number of readings versus the number of times each reading appears form of a histogram, or bar graph.
- A smooth curve drawn through the top of the bars will be bell-shaped and will peak at or near the true value.

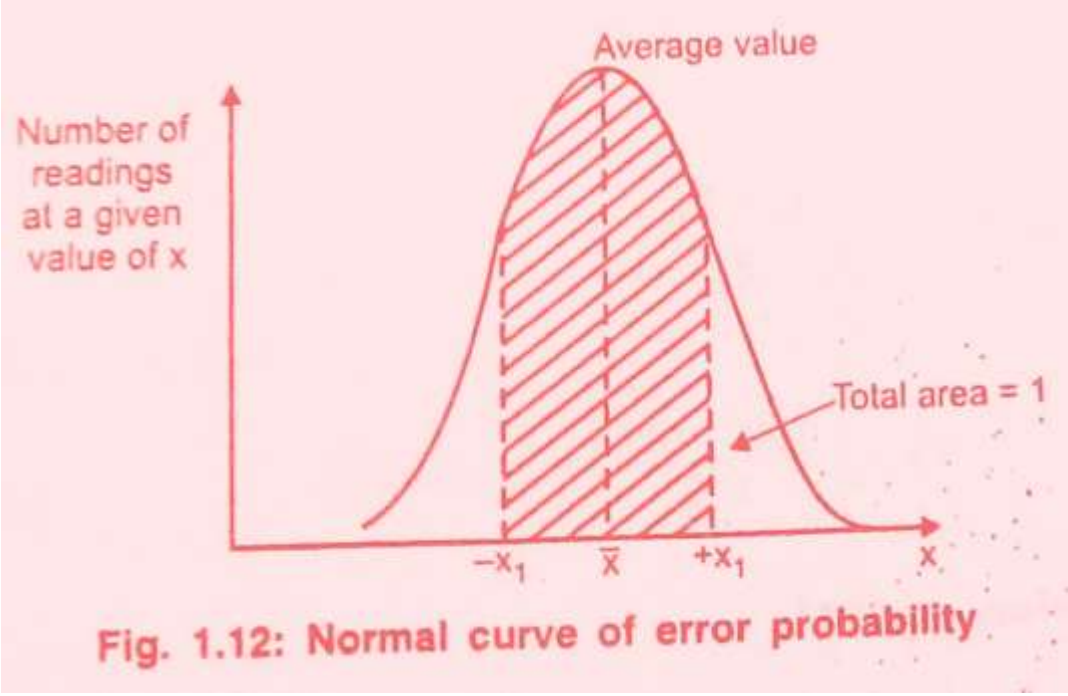

Fig. 1.12: Normal curve of error probability

CLASS WORK PROBLEM

1. The following table gives the set of 5 measurement that were recorded in the laboratory. Calculate the precision of the 4^{th} measurement.

1-98

2-102

3-101

4-103

5-106 Precision $P = 1-|X_n-\bar{X}_n|/\bar{X}_n$

SUMMARY

STUDENT'S CORNER

Work sheet

1. If a set of six observations as follows:

1.5V, 3V, 1V, 5V, 2V, 4V.

Calculate the arithmetic mean, average deviation.

THANK YOU