ERROR IN NUMERICAL COMPUTATION

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Exact Number

Numbers we use in counting and defining other quantities are assumed to be exact and to have an infinite number of significant figures. There is not any sort of uncertainty in their values. An exact number cannot be simplified or reduced.They are the result of counting discrete items.For example:-

- Number of ounces in a pound
- Any counted number, such as the number of apples in a bag
- A dozen eggs is exactly 12 eggs

Approximate number

An approximate number is a number that is close but not exactly equal to another number . Any measured value contains inherent uncertainty. The uncertainty comes from the limit of the measuring device and the skill of the person performing the measurement.

For example , if a grocery store is selling 3 candy bars for $1.00. At this rate, the cost of each candy bar will be:-$1.00 ÷ 3 = $0.\overline{3}$, where the line over the 3 indicates that it repeats indefinitely. This means that the real value is somewhere between $0.33 and $0.34, since 0.3 cannot be expressed exactly in decimals. Both $0.33 and $0.34 are approximate numbers for the exact cost of each bar. It is not possible to charge a customer $0.3, so instead we could say that he was charged $0.33 for two candy bars, and $0.34 for the third candy bar.

<u>Truncation and Rounding Off Errors</u>

<u>Round-off Errors</u>: It arises when a calculated number is rounded off to a fixed number of digits; the difference between the exact and the rounded off number is called Round-off error. We can minimize this error by taking more decimal places during the calculation and at the last step round- off the number upto its desired accuracy.

Ex: Let the exact number = 29.3257 Its 3 decimal places approximation 29.326 = Therefore, the Round-off error= (29.3257 ~ 29.326)

<u>Truncation Errors</u>: If approximation is used or infinite process be replaced by finite one during calculation, then the errors involved are called Truncation Errors. We can minimize this error by taking more decimal places during the computation or by taking more terms in the infinite expansion.

Ex: $\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots$

Let this infinite series be truncated to cosx = $1-\frac{x^2}{2!}+\frac{x^4}{4!}$=C (say)

Then the truncation error = (cosx~ C)

Rules for rounding off numbers:-

- If the digit to be rounded off is more than 5,then the preceding digit is increased by 1.eg:-6.87$\cong$6.9
- If the digit to be rounded off is less than 5,then the preceding digit is unaffected and is left unchanged.eg:-3.94 $\cong 3.9$
- If the digit to be rounded off is 5, then the preceding digit is increased by 1 if it is odd and is left unchanged if it is even.eg:-14.35 $\cong 14.4$ and $14.45 \cong 14.4$

Absolute Error

The Absolute error of a quantity is the absolute value of the difference between the true value X and the approximate value x. It is denoted by:-

$$E_A = | X - x |$$

<u>Relative Error</u>

The relative error of a quantity is the ratio of it's absolute error to it's true value. It is denoted by:-

$$E_R = \frac{E_A}{X}$$

<u>Percentage Error</u>

Percent error formula is the absolute value of the difference of the measured value and the actual value divided by the actual value and multiplied by 100%.The formula is:-

$$PE = E_R \times 100$$

CONCLUSION

Mathematical Errors can give us insight into their misconceptions and, depending on our instructional reactions, can enable them to develop deeper understanding of the mathematics they are learning. How we respond to productive errors can encourage or discourage our thinking and learning.

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