

e-ISSN: 2319-8753 | p-ISSN: 2347-6710

EDIA

International Journal of Innovative Research in SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 7, July 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

 \bigcirc



International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)



| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569|

|| Volume 10, Issue 7, July 2021 ||

DOI:10.15680/IJIRSET.2021.100312 |

Comparison of Normal Process and Calculus Process to Find the Variation of a Non Linear Function

Dr. Somnath Bhattacharya

Assistant Teacher, Department of Physics, Sutahata Janakalyan Sikshaniketan (H.S), Haldia , West Bengal , India

ABSTRACT : Theoretical calculations of variation of some non linear functions in scientific educational fields are required often. For this reason normal variation process is used. But calculus is used for the same by many students. But the two process give different results as the variation becomes higher and higher. In this paper a clear demonstration has been given about this matter.

KEYWORDS : Normal variation process, Logarithm, Differentiation, Percentage.

I. INTRODUCTION

For studies science stream in generally higher secondary, graduation level etc students have to face some problems regarding the percentage change of any variable which is dependent non-linearly on another variable i.e function (in mathematical term) of that which is when varied by any certain percentage. This calculation can be done by two process, on e is general method but other is method using differentiation. For small change the two process give nearly same results. But when the percentage of the variation is increased gradually the results get started to be different. The description about the matter will clearly give any student about the idea that which process should be adopted to do the aforesaid calculation when asked to do in exam or anywhere.

II. THEORETICAL CONSIDERATIONS

We know that relation between two variables "Y and X" is generally expressed as Y=F(X) i.e Y is dependent on X or function of X. Now X is varied by any amount so Y will also change. If X is changed from X1 to X2 then Y is also changed from Y1 to Y2. Then change through ratio can be expressed as $\frac{Y2-Y1}{Y1} = \frac{F(X2)-F(X1)}{F(X1)}$

Now if the value of X is changed by N % then we can write $X2 = X1 \pm X1 \times N/100$ (1) and the variation of Y can be calculated by normal way.

Now the process of differentiation can be used as follows.

At first taking the Logarithm of both sides of equation Y=F(X) and then differentiating we have finally the equation as $\frac{dY}{Y} = \frac{F'(X)}{F(X)} dX \qquad (3)$

where dY, dX are the variation of Y and X respectively and F'(X) is the first order derivative of F(X). The LHS of the equation 2 is the variation of Y in ratio form which can be calculated if form of F(X) is known.

In this paper we only consider the simple function $F(X) = X^m$ as non linear one taking the value of m = 2, 3, 4 and 1/2, 1/3, 1/4 serially.

International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)



| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569|

|| Volume 10, Issue 7, July 2021 ||

|DOI:10.15680/LJIRSET.2021.100312 |

III. RESULTS & DISCUSSIONS

Here a simple FORTRAN program has been made to evaluate the difference in variations of F(X) due to the percentage change of X from 1 to 50 by steps of one. Symbols used in the table have the following meanings. $\Delta(X^m) =$ Value of difference of variations of $F(X)=X^m$ for normal and calculus process where m having the values as said before 2,3,4 and 1/2, 1/3, 1/4 as fractional case. This difference in variation of two process has been calculated by subtraction of variation by calculus method from that of normal method. Depending on it $\Delta(X^m)$ may be positive or negative. (Given in Table -1)

| Table | 1:- | Values of | difference o | of two | variations for t | wo proc | cesses for | change of | X |
|-------|------|------------|--------------|---------|------------------|---------|------------|-----------|------------|
| Table | T •- | v alues of | uniterence o | 1 1 100 | variations for t | mo pro | | change of | 7 P |

| Change of X | $\Delta(X^2)$ in % | $\Delta(X^3)$ in % | $\Delta(X^4)$ in % | $\Delta(X^{1/2})$ in % | $\Delta(X^{1/3})$ in % | $\Delta(X^{1/4})$ in % |
|-------------|--------------------|--------------------|--------------------|------------------------|------------------------|------------------------|
| in % | | | | | | |
| 1 | 0.009 | 0.030 | 0.060 | -0.001 | -0.001 | -0.000 |
| 2 | 0.039 | 0.120 | 0.243 | -0.005 | -0.004 | -0.003 |
| 3 | 0.089 | 0.272 | 0.550 | -0.011 | -0.009 | -0.008 |
| 4 | 0.160 | 0.486 | 0.985 | -0.019 | -0.017 | -0.014 |
| 5 | 0.240 | 0.762 | 1.550 | -0.030 | -0.027 | -0.022 |
| 10 | 0.999 | 3.100 | 6.410 | -0.119 | -0.105 | -0.088 |
| 15 | 2.249 | 7.087 | 14.900 | -0.261 | -0.231 | -0.194 |
| 20 | 4.000 | 12.800 | 27.360 | -0.455 | -0.400 | -0.335 |
| 25 | 6.250 | 20.312 | 44.140 | -0.696 | -0.611 | -0.512 |
| 30 | 9.000 | 29.700 | 65.610 | -0.982 | -0.860 | -0.721 |
| 35 | 12.250 | 41.037 | 92.150 | -1.310 | -1.145 | -0.958 |
| 40 | 16.000 | 54.400 | 124.160 | -1.678 | -1.464 | -1.224 |
| 45 | 20.250 | 69.862 | 162.050 | -2.084 | -1.814 | -1.515 |
| 50 | 25.000 | 87.500 | 206.250 | -2.525 | -2.195 | -1.831 |

IV. GRAPHICAL REPRESENTATIONS

Difference in variation of F(X) in % vs percentage change of X graph





International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)



| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569| || Volume 10, Issue 7, July 2021 ||

DOI:10.15680/IJIRSET.2021.100312

The values of difference of variations $\Delta(X^m)$ are continuously increasing with respect to the change of X variable. It becomes nearly zero for lower variation less than 10. So they give almost same result for low variations. But as the change of X increases the values of $\Delta(X^m)$ is non linearly increases heavily. The values of $\Delta(X^m)$ is most for m=4 i.e it increases with the increase of power of X.



Difference in variation of F(X) in % vs percentage change of X graph

Fig 2. Difference of variations of $F(X) = X^{1/2}$, $X^{1/3}$ and $X^{1/4}$ with respect to change of X

Here the values of Difference of variations $\Delta(X^m)$ are negative as per our assignment and also continuously decreasing with respect to the change of X variable. It becomes very small for all variations and have very small values as compared to values of $\Delta(X^m)$ for m=2,3,4. The values of $\Delta(X^m)$ is least for m=1/4 and most for m=1/2 .i.e it gives the opposite features of the Fig 1.

V. CONCLUSIONS

So we can make here a solid conclusion that for lower variation of function both process can be used as calculus is generally used for small scale. But for bigger variations normal method should be used otherwise there will be obvious mistake when such calculations will be asked to do. It is obvious to say that for m=0 i.e for linear function both the processes give the same results for any variation.

In Physics there are various non linear equations like $T = 2\pi \sqrt{\frac{l}{g}}$, $n = \frac{1}{2l} \sqrt{\frac{T}{m}}$ etc. where symbols have their usual meanings. The problems regarding the change of any quantity depending on some change of others are very common both in written exam and practical purpose also. The aforesaid method can be easily used in such cases for right calculations.

REFERENCES

Jana D, Bera S.K , Pal S & Jana M – Authors of Essential Physics XI (Santra Publication Private Limited)
Karmakar S , Khamrui S.K & Bandyopadhyay C.K – Authors of Essential Mathematics XI (Santra





Impact Factor: 7.569





INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY





www.ijirset.com