**LOGARITHMS**

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# Introduction

* Representation of the exponent of a natural number
* It can help to simplify power factors of a number (MEI, 2018)
* This study provides an overview of logarithm function and its application
* This study helps to recognize the history of development of logarithmic function (Siam, 2019)

Application of the logarithm in mathematical domain is used for realizing the nature of power factors associated with a function with the help of graphical representation. This study can help to determine different aspects related to this function and it application in different fields along with the history associated with the invention of this factor. Moreover, this study illustrates different formulas related to the logarithms.

* Sometimes this functions are called opposite exponentiation function
* According to the base of the logarithm the nature of the logarithm function can be determined (Famousscientists, 2019)
* Logarithmic function with base 10 can be considered as common logarithm
* Logarithmic function with base ‘e’ is called the natural logarithm (Mathforum, 2015)

Since logarithm of a function behaves opposite to the exponentiation function hence this function are called opposite exponentiation. Logarithm with irrational number ‘e’ in the base called natural logarithm and sometime these functions are represented without any base such as- logx. On the other hand, logarithm with 10 in the base can be considered as common type logarithm.

* Application of logarithm can be seen in different field such as in business planning, economics (Maths, 2014)
* The logarithm with base ‘e’ called ‘ln’ (Maa, 2018)
* ‘ln’ and ‘log’ functions have difference in their value
* The application of ‘ln’ and ‘log’ functions also are significant (Maa, 2018)

Application of logarithm can be seen in different fields such as in business planning and in economics. In business planning logarithm are used to determine the return on investment by which the potential risk of business can be determined. On the other hand, in economics logarithms can be for determining the growth rate of inflation. Differences in the value can be seen in common and natural logarithm hence the application of these two operators is different.

* This study will show different pros and cons associated with logarithm
* This study can help to provide proper knowledge related to the application of logarithm (Umass, 2015)
* The approximate value of ‘e’ in common logarithm is 2.718 (MEI, 2018)
* With the addition operation of logarithm the exponents of this function are multiplied

This study can help to realize different advantages and disadvantages of logarithmic function and application of this function in different fields. One of the main properties of logarithmic function is whenever one tries to add two logarithmic functions the exponents of these products are multiplied.

* This study can help to realize the drawbacks of logarithmic function
* Difficulties in the analysis of exponential factors can be considered one of the main disadvantage of logarithmic function (Siam, 2019)
* In physics for realizing the characteristics of elastic phenomenon of a material logarithm is used

Logarithmic function can be applied for realizing the elastic nature of a substance. One of the major drawback of logarithmic function is the process of analysis with the help of logarithmic function is difficult.

# History

* John Napier has developed logarithmic function
* The name of logarithm is the combination of two Greek terms ‘Logos’ and ‘Arithmus’ (Maths, 2014)
* Napier had developed logarithm for mitigating issues related to the calculation of astronomy
* Logarithm was the first replacement of trigonometric identity function

John Napier can be considered, as the father of logarithm and behind the discovery of this function was to mitigate the issues related to application of trigonometric identity function in astronomy. Application of logarithmic function has solved issues related to the complexity of trigonometric identity function such as 2 cos (P) cos(Q)= cos (P+Q) + cos (P-Q). In the trigonometric identity function, three steps were required for solving the equation and find out the value of the function. With the help of logarithmic function, this problem can be solved more reliably.

* Application of logarithm has simplified the calculation of exponential functions (Maa, 2018)
* Napier discovery has helped to increase the effectiveness and simplicity of mathametical operations
* After this John Bernoulii has attempted to find out the value of logarithm of negative number (Maa, 2018)
* Bounoulii found that logarithm of negative function provide positive value

John Napier discovery of logarithm has helped to mitigate the problems of complexity associated with the logarithm. Long after John Napier, invention of logarithm Bernoulii a renoowned physicist found out that logarithmic function of a negative integer provides positive value. From this point of view, it can be stated that logarithm provides the real value of a function.

* Napier considered kinematic framework for developing logarithmic function
* In this regards Napier has considered two infinite and finite line segments (Umass, 2015)
* The logarithm of sine of finite line can help to describe the nature of first line
* Hence for increment in the sine factor the value of logarithm is increased

Napier has discovered that if one considered two lines having collinear points on them and the distance among these points are equal then second line can be assumed as sine with reference to this first line can be described as the logarithm of this sine function. Hence, from this perspective it can be stated that with the help of a finite line segments an infinite line segment can be described.

* John Napier developed an table called logarithmic table
* This table provides values of logarithmic factors having real exponents (MEI, 2018)
* Napier has developed this table by increasing the angle of the arc of logarithmic function
* In this manner John Naprier developed the values of minutes related to the logarithmic arc (Siam, 2019)

John Naprier develops the table of logarithm by increasing the arc values and taking values for each angle. Napier’s table provides logarithmic values of all natural numbers by which large exponential functions can be solved. Values of these exponential factors can help to solve different problems associated with geometric means. From this point of view, it can be stated that Napier’s invention has helped to increase the effectiveness of statistical operations. Napier in the logarithmic table considered the value of the angles of Arc angle 0° to 45° and found out the values of the logarithmic function for these angles.

# Application of logarithms

* The main concern behind the application of logarithm is transforming exponential function into a linear function.
* The logarithmic equations are designed to transform these exponential functions for the critical understanding of function (Galbraith & Gaudry, 2016).
* Real world application of logarithm is vast.
* Along with the field of mathematics, it is applied in the field of chemistry, physics, and other grounds of academics.

 The key purpose of logarithm application is providing problem-solving approaches using the critical intervention of mathematics and statistics. Nonetheless, functional limits are also determined through the effective application of logarithms. Understanding the limit of a function is necessary for the proper orientation of function. Hence, using the limiting values, after observing from logarithms application, certain functions can be operated within the range of its orientation.

* Logarithms help in the determination of functional limits.
* Logarithms can be applied in research works, for determination of the error value of the research.
* Discrete logarithms are applied in the field of business (Joux & Pierrot, 2016).
* Intensity measurement of an earthquake can be conducted using the effective interpretation of logarithms.

Measuring the intensity of an earthquake is hectic in nature, which can be evaluated with the appropriate application of logarithms. Likewise, larger values can be managed and expressed with the suitable approaches of logarithms. However, in the field of chemistry, using logarithmic functions, acidity (pH-value) can be measured by the chemists. Similarly, the sound intensity of daily life can be measured by the application of logarithmic functions. Therefore, using this function large field of academics and real world can be served.

# Pros and cons of logarithm applications

**Advantages**

* The rate of change can be represented graphically, using the logarithmic functions as an operator.
* The data value can be elevated for small inputs.
* Logarithmic scale can be used as a statistical auxiliary (Wenger & Wolfger, 2016).
* Resolving exponential functions into linear functions, logarithms can improve the understanding for people.

 The key advantage of the application of logarithm can be considered as transformation of exponential function into the linear function. Since exponential functions are hard to understand, for the general people, thus, using the logarithmic application, simplification can be conducted. In a similar vein, plotting large value in graph paper is not possible using ordinary mathematical approaches. In this context, logarithm considers 10 as base value of the function and thereby large values can be plotted in the graph papers quite easily.

**Disadvantages**

* Error plotting may be easy using logarithm, however, proper evaluation of error may be denied.
* The process of analysis is difficult in nature (Bernstein *et al.* 2016).
* Plotting null value is not possible using logarithm scale.
* Using the same graph, both positive, as well as negative value, cannot be represented.

 In spite of vast field of application, logarithm applications are solely dependent on the base value of the function. Hence, according to the change of base value, output of the logarithm differs. Likewise, using the logarithm function, zero cannot be represented. Hence, null value is denied by the function and viability of information reduces thereby. Moreover, reciprocal nature of logarithm, in context to an exponential function, deprives the nature of calculation. Thus, exponential graphs cannot be prepared using logarithm graph papers.

# Conclusion

* Logarithm can be used for the simplification of exponential factors into linear one.
* Power factors of function can also be simplified using the logarithm.
* Logarithm can be considered as a reciprocal function of exponential function.
* In general, ‘10’ is considered as base value for the application of logarithm scale.

From the above study, it can be seen that logarithm is considered for simplification of the exponential function. Apart from this, representation of power can be conducted using the logarithmic values. It has been observed that the nature of power varies with changing variables of a function. Hence, change in the power can be demonstrated using the logarithm function. On the other hand, ln is used for the logarithms when ‘e’ is considered as the base value of the function.

* Logarithm can be applied in different field of studies and researches, according to the operational needs.
* Error of a function can be determined and represented using the logarithm scales.
* In real life application, field of business can be covered using the logarithm function.
* Intensity of earthquake can be measured through the effective application of logarithm.

 Apart from academic studies, logarithm has vast application in real life operations. As for an example, using the discrete logarithm, various portion of business study can be conducted. Likewise, using the logarithm function, small values can be intensified and thereby it can be represented for proper evaluation. Meanwhile, huge values representation can be considered as an advantage of logarithmic application, whereby changes in the variables can be identified in a critical manner.

* John Napier is considered as father of logarithm due to his invention of logarithmic function.
* Simplification of astronomical calculation has remained the core objective behind this development.
* In order to replace trigonometric identity function, Napier has developed logarithm.
* Using logarithm, pH-value can be identified for acidity evaluation in chemistry.

 Calculation of astronomy is a critical matter and requires proper attention. Therefore, John Napier has developed the concept of the logarithm, whereby complexity of such calculations is dwindled down significantly. Besides this, trigonometric identity is replaced after the effective application of logarithm. Nonetheless, in the field of chemistry, calculation of pH-value is hectic process and effective application of logarithm offers an opportunity for the chemists to evaluate the acidity in a simple manner.

* Logarithm outputs are changes with changing base value.
* Using logarithm graph, null value cannot be represented.
* Inside the same graph paper, both positive and negative changes cannot be plotted in logarithm scale.
* Application of logarithmic scale acts as a statistical auxiliary in the field of study.

 It has been observed from the study that apart from advantages, several drawbacks are impacting the vast application of logarithm. As for an example, logarithm scale is unable to plot null value. Therefore, the reliability of value is deprived to some extent during the evaluation of the function through logarithmic operator. Additionally, as per the change, in base value of logarithm, output differs from its previous value. Moreover, one cannot represent both positive and negative value of logarithm inside the same graph. Despite these drawbacks, effectiveness of logarithm has enhanced its utilization and it is considered as a statistical auxiliary.