Asian Journal of
Science, Technology, Engineering, and Art

e-ISSN : 3025-4507
p-ISSN : 3025-5287

Index : Harvard, Boston, Sydney University, Dimensions, Lens, Scilit, Semantic, Google, etc

https://doi.org/10.58578/AJSTEA.v2i3.2863

STUDY AND ANALYSIS OF SOME REAL LIFE APPLICATIONS OF EXPONENTIAL FUNCTION BASED ON POPULATION GROWTH RATE OF NEPAL

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Article Info:

Submitted:	Revised:	Accepted:	Published:
Mar 20, 2024	Mar 31, 2024	Apr 5, 2024	Apr 9 2024

Abstract

This research investigates various real-world applications of exponential functions that are present in a country or region. Our goal was to gain an understanding of the exponential function. The exponential function is most commonly used in the growth and decay model. An introduction to the exponential function opens the project. We have got some real-world applications of the exponential function in this project, including: a. population growth: b. compound interest; c. bacterial proliferation; d. an increase in internet users; and so on. This work is motivated by the works of [1-13].

Keywords: Exponential Function, Population Expansion, Model, Compound Interest, Examples, Growth, Decay

Introduction

In every field-science, engineering, and economics, for example—the exponential and logarithmic functions are crucial. There are exponential functions in addition to quadratic and linear functions. Leonhard Euler made the exponential function concept known. In economics and management, the exponential and logarithmic functions are frequently utilized. Salvage value is computed using these functions. Exponential functions are utilized for demographic modeling, composite investment, death time determination, and other purposes.

Johann Bernoulli researched exponential function calculus in 1697. Although the idea of an exponential function dates back thousands of years, it wasn't until the 17th and 18th century that it was formalized and studied. In 1614, John Napier presented the concept of logarithms, and a year later, in 1620, Henry Briggs expanded it to the base of 10. The understanding of exponential growth and decay is made possible by these developments. A notable contribution was made by the mathematician Leonhard Euler in the eighteenth century when he defined the exponential function with base "e" (Euler's number). In calculus, where the exponential function is essential to many mathematical applications, the notation "e" became fundamental. A mathematical function with the formula $f(x) = a^x$, where "x" is a variable and "a" is a constant that is referred to as the function's base and must be greater than zero, is an exponential function. The transcendental number e, or roughly 2.71828, is the most widely used exponential function basis. The formula f(x) = ax, where the input variable x appears as an exponent, defines an exponential function. The exponential curve is dependent on both the value of x and the exponential function. The exponential function, represented by the formula $f(x) = a^x$, is a significant mathematical function. Here, "a," the function's base, is a constant, while "x" is a variable.

The exponential function determines whether an exponential curve increases or decreases. Exponential growth or exponential decay characterize any number that increases or decreases by a constant percentage on a regular basis. Since then, exponential functions have grown to be essential in many disciplines, including as computer science, physics, biology, and finance, for explaining events that exhibit rapid growth or decay. In real life, it is utilized to calculate compound interest, depreciation, population expansion or decay, bacterial proliferation, and other things (see [18-25]).

Definitions:

Unlimited growth function:

The function modeled by the equation $f(t)= ae^{rt}$, where a and r are constants, is called unlimited growth function. Population growth, investment are the examples of unlimited growth function.

Unlimited decay function:

The function modeled by the equation $f(t)=ae^{-rt}$, where a and r are constants is called unlimited decay function.

Limited growth function:

The function modeled by the equation $f(t)=M(1-e^{-rt})$ where M and r are constants, is called limited growth function. Consumption function, sale with advertising are the example of limited growth function.

Logistic growth function:

The function modeled by the equation $f(t)=M/1+ ae^{-rMt}$, where M, a and r are constants, is called logistic growth function. Sale, constrained population growth are the examples.

Discussion:

The function $p_t = pe^{rt}$, where "p" is the initial amount, "r" is the percentage increased, and "t" is the time in the year, can be used to predict the amount of a given quantity after "t" years if it increases by a certain percentage each year. Likewise, depreciation is the term used to describe an asset's gradual decline in value. The formula for calculating the scrape value, "s," using the exponential model is $S=Ve^{-rt}$, where "V" stands for the initial price, "r" for the rate of depreciation, and "t" for the amount of time in years.

There are numerous practical uses for exponential and logarithmic functions, and they are related to one another. For example, logarithmic functions are useful for calculating the size of the earth, sound intensity, product acidity, product alkalinity, and many other quantities. Similarly, compound interest, population growth/decline, and bacterial growth/decay can all be measured and computed using exponential functions.

Similarly,We can state some problem related to population growth rate in Nepal

*Problem 1:

A town has a population of 40000 that is increasing at the rate of 5% each year. Find the population after 10 years.

Solution;

P = 40000

P_t = ?

T = 10 years

R = 5%

Now,

$P_e = Pe^{rt}$

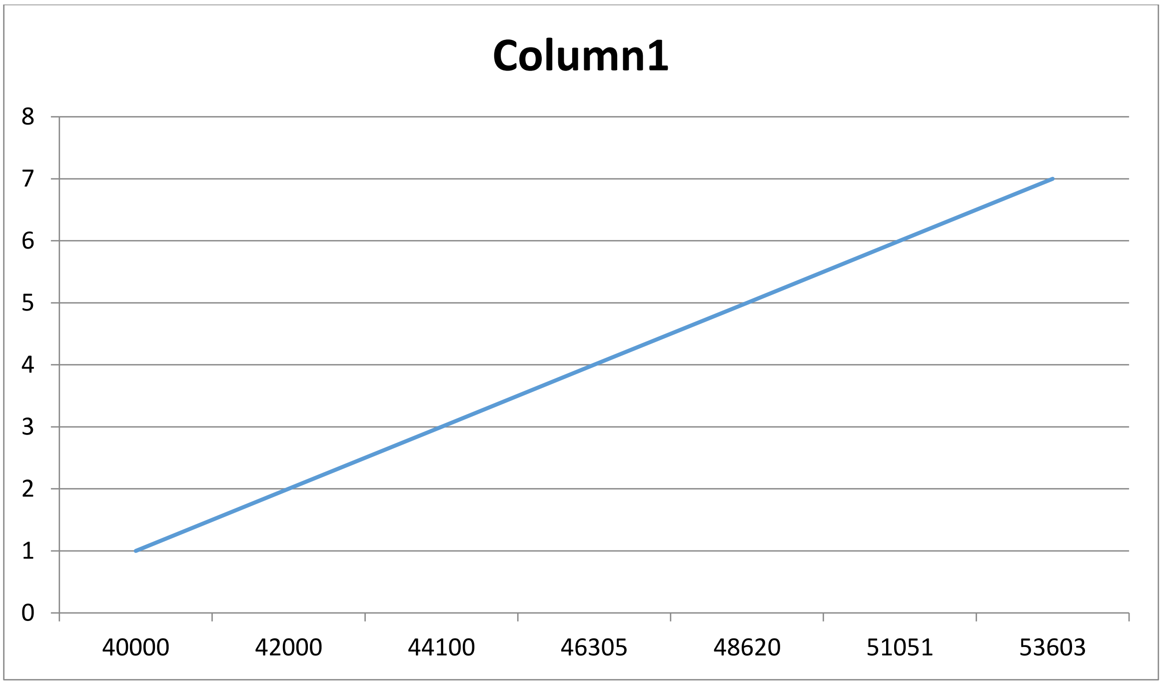
$=40000*e^{(0.05*10)}$

$=40000*1.648$

P_{10} =65949

Since the population of town after 10 years is 65949.

Representing the above information in Diagram way



Stating: X-axis represent the Population of a town whereas, Y-axis represent the Year

*Nepal population growth rate, density and percentage of urban population

Population measures	Census years				
	1971	1981	1991	2001	2011
Population (millions)	11.6	15.0	18.5	23.2	26.5
Growth rate ®	2.1	2.6	2.1	2.25	1.35
Density (pop./km^2)	79	102	126	158	181
%of urban population	4.0	6.4	9.2	14.2	17.0
Source – national population censuses, 2001and 2011					

The above data represent the population of Nepal in census between 1971 and 2011A.D.

For computing arithmetic growth rate, we can solve the equation of $P_t=P_0(1+rt)$, then

$P_t = P_0 + P_0rt$

Or, $P_t – P_0 = P_0rt$

Or,$(P_t – P_0)/P_0t = r$

Or, $r= (P_t – P_0)/P_0t$

The growth rate is expressed in terms of per cent and it is given below.

$r= (P_t – P_0)/P_0t*100$

Thus the arithmetic growth rate during 2001 and 2011 is computed by using above formula. The censuses data are $P_t = P_{2011} = 26494504$ in 2011 and $P_0 = P = 23151423$ in 2001 and t = 2011-2001 = 10 years.

$r= (P_{2011} – P_{2001})/P_{2001} * t *100$

$= (26494504 – 23151423)/23151423*10 *100$

= 1.44 per cent per annum.

*Problem 2:

The continuously interest models follow the exponential formula

$A=P_e^{rt}$

Where,

A= future value

P=principal or initial value

r=interest rate

t=time

lets solve some problem related to compound interest

*Ram want to invest his saving at a bank. He invest Rs5000 at 6% continuous interest. How much will be his money after 5 years.

Given that,

P = rs5000

r = 6% as a decimal 0.06

t = 5 years

A = ?

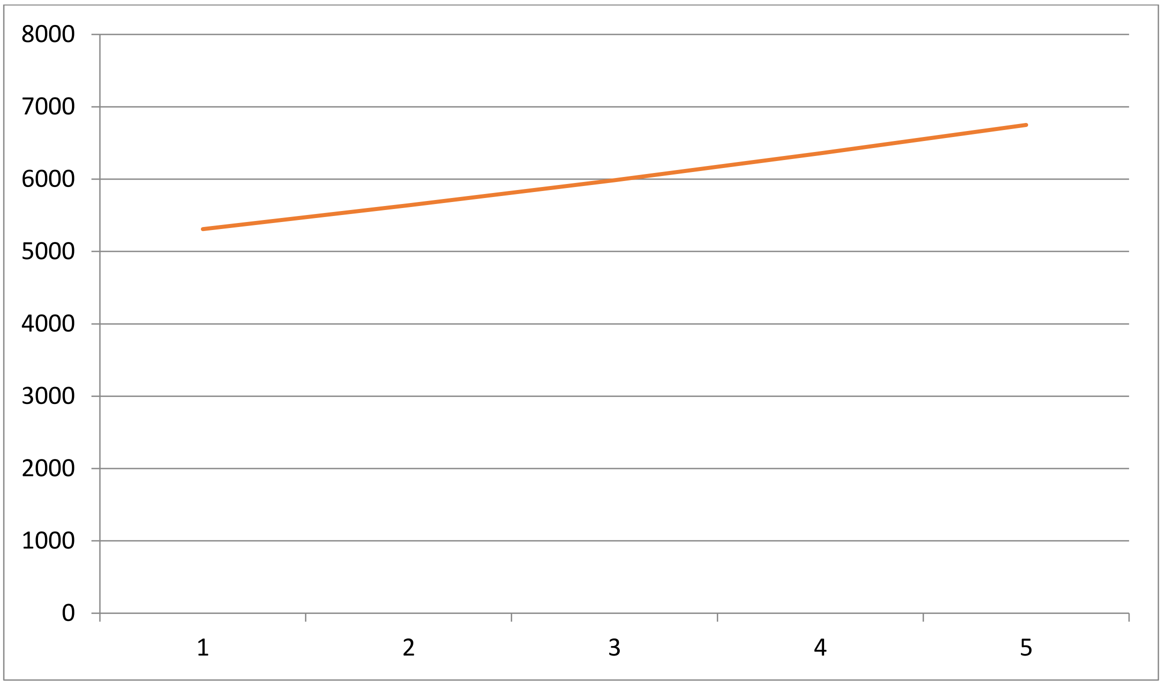
We have,

$A = Pe^{rt}$

$= 5000*e^{(0.06*5)}$

= Rs6749.29

Thus the amount after 5 years will be Rs6749.29



The above diagram represent the continuous compound interest for the following next 5 years.

*Problem 3:

The number of internet user in 2080 is 1000000. The number of internet user is increasing with increasing rate @15% every year. What will be the population of internet user at the end of 2085.

Given that,

P= 1000000

r= 5% as decimal 0.05

t= 5 years

P_5= ?

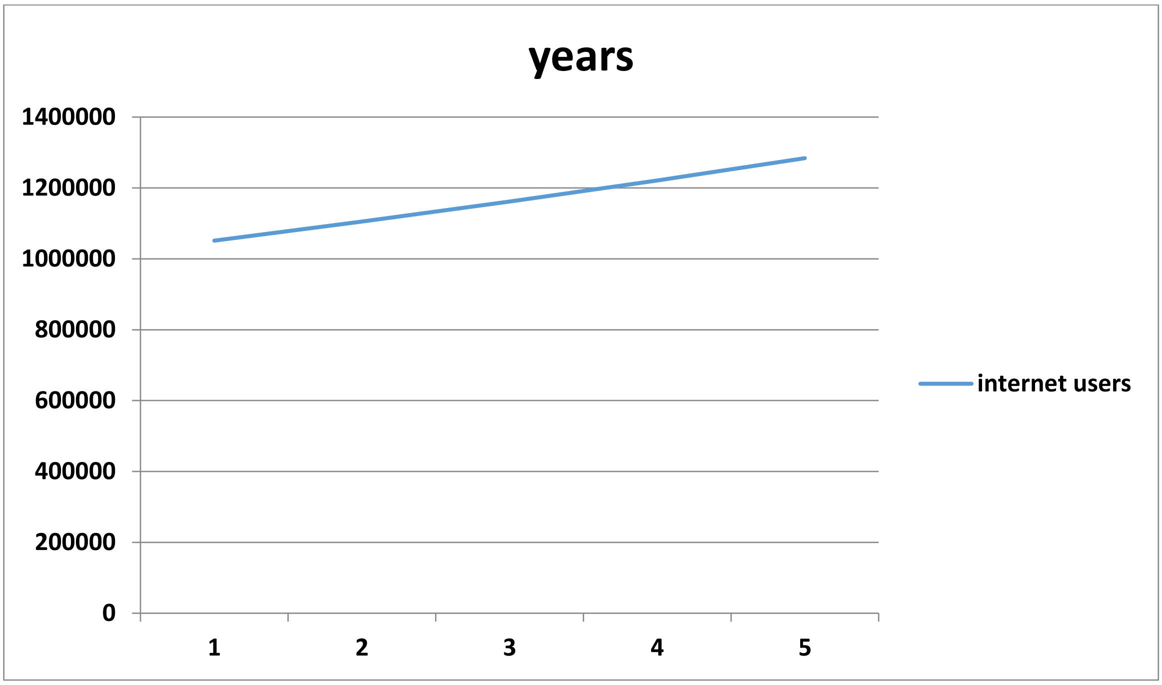
Now,

$P_5 = Pe^{rt}$

$= 1000000e^{(0.05*5)}$

=1284025.42

Therefore the internet user after 5 years will be 1284025.42



The above diagram represent the increasing in internet user for contuinuous 5 years
.

The Following above numerical and diagramatic problem Expressed as a exponential function.

conclusion:-

Thr estimate the present paper\document population growth, internet users, compound Interest. The trends of population growth rate were found to be in 1981 and again it was found in 1991. In 2001 and it came down to 1.35% annually in 2011. About 4% population were residing in urban arcas. In 1971, 6.4% in 1981, 9.2% in 1991, 14.2% 2001 and 17% in 2011. compound interest is also show in the document which represent the yearly interest paid by the people for the certain period of time compounding periods are the time intervals between when the interest is added to the account. Interest can be compounded annually, semi-annually, quarterly, monthly, daily, continuously or on any other basis. From the above Example, we can state that compound interest is simply interest on your Interest and it grow faster of Sum of money when the greater the compound interst growth will be shown as shown in problem 2.

Another problem is solved related interest users. As shown in diagram we can say that the how interest user is incereasing With certain rate for the certain period of time. From the down in 2080 the internet user is 1000000 but when it cross the upcoming next 5 years, the users are increased upto 1284025. So, we can basically applied the exponential function in our daily life basis (see [14-17]).

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