PREDICTING GROSS DOMESTIC PRODUCT (GDP) USING DIFFERNTIAL EQUATION

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ABSTRACT

In this mini project, we discuss about predicting GDP calculation using Differential equation in Economics. Mathematical Modeling in economics became central to economic theory during a decade. In this chapter, some application of differential equations in economic growth like Capital and Business trade cycle. Differential equation in modern dynamic economic modeling our extensions and modification of these classical works. Finally, differential equation presented in this chapter is introduced to model GDP.

KEYWORDS: GDP definition, GDP of 2030, Applications of differential equation in economics.

INTRODUCTION

Differential Equations have become an essential tool of economic analysis. It may be difficult to apprehend the literature of modern age without understanding the fundamental concepts (such as bifurcations and chaos) and the outcome of the recent theory of differential equations.

Differential Equations are very helpful to study the 'Macro Economic Theories' and the 'Theories of Economic Growth'. Application of Digital of Differential Equations in Economics is abundant. A few of the mare Multiplier and Accelerator Interaction and cob-web Model and Trade Cycle. The utilization of differential equations to economic analysis is also much. For instance, a differential equation expresses the derivative of the the current state as a function of the current state.

GROSS DOMESTIC PRODUCT(GDP)

Gross Domestic Product(GDP) is the total monetary or market value of all the finished goods and services produced within a country's border in a specific of time. As a broad measure of over all domestic production, it functions as a comprehensive scorecard of a given country's economic health.

Though GDP is typically calculated on an annual basis, it is sometimes calculated on a Quarterly (i.e.Q1, Q2, Q3, and Q4). The individual data sets included in this report are given in real terms, so the data is adjusted for prices changes and is therefore, net of inflation.

- GDP provides information about the the production of goods and services in a country during a certain period, used to determine the size of an economy and growth rate.

- GDP can be calculated in three in economic field using expenditure, production, or incomes. It can be adjusted for inflation and population to provide deeper insights.

- GDP is a key tool to guide policy makers ,investors and businessman in strategic decision making.

The calculation of a country's GDP encompasses all private and public consumption, government outlays, investments, additions to private inventories, paid- in construction costs and the foreign balance of trade of all the components that make up a country's GDP, the foreign balance trade is especially prior.

The GDP of a country tends to increase when the total value of goods and services that domestic producers all set to foreign countries exceeds the total value of foreign goods and services that domestic consumers buy. When this situation occurs, a country is said to have a trade surplus.

If the grand total of domestic producers are less than the amount that are spent on foreign products then we are able to sell to foreign consumers. It is called TRADE OF DEFICT. In this, GDP of a country tends to increase.

GDP can be computed on a nominal basis or areal basis, the latter accounting for inflation. Overall real GDP is better methods for expressing long term economic performances in ceit uses CONSTANT DOLLARS.

TYPES OF GROSS DOMESTIC PRODUCT

I.   Nominal GDP:

Nominal GDP is an assessment of economic production in an economy that includes current prices in an economy that includes current prices in its calculation. In otherwords ,it doesn't strip out inflation or the pace of rising prices,which inflate the growth figure. Nominal GDP is evaluated in either the local currency or US dollars at currency market exchange rates to compare countries GDP in purely financial terms.

II.   Real GDP:

Real GDP is an inflation adjusted measure that reflects the quality of goods and services produced by an economy in a given year, with prices held constant from year to year to separate out the impact of inflation or deflation in output overtime.

GDP PRICE DEFLATOR is used to find Real GDP, which is the difference in prices between the current year and the base year.

III.   GDP PER CAPITA:

GDP per person in a country's population yields GDP per. It indicates that the amount of output or income per person in an economy can indicate average productivity. Nominal, real or ppp terms states GDP per capita.

   GDP per capita is calculated by considering both a country GDP and its population.

   GDP per capita = GDP of a country

                        Population of a country

GDP GROWTH RATE:

The Growth rate compass the year-over year(over quarterly) change in a country's economic output to measure how fast an economy is growing. Expressed as percentage rate.

If GDP growth rates accelerate, it may be a signal that the economy is 'overheating' and the central bank may seek to rise interest rates.

GDP PURCHASING POWERPARITY(PPP)

Economic look at purchasing power parity(PPP) to see how one country's GDP measures up in 'International Dollars'.

INDIA'S GDP RATE OVER THE YEARS:

2014 -2.03$TRILLION
2015-2.10$TRILLION
2016-2.29$TRILLION
2017-2.65$TRILLION
2018-2.70$TRILLION
2019-2.87$TRILLION
2020-2.66$TRILLION
2021-2.94$TRILLION

General GDP formula using differential equation:

$$\frac{dy}{dx} = g * y(t)$$

Where g is the growth rate at time t and y(t) is GDP at time t(Measured in Dollars). Using Integrating factor method to solve,

$\frac{dy}{dx}$ -gy=0

$\mu(t) = e^{\int -g dt} = e^{-gt}$

$\frac{d}{dt}(e^{-gt} * y) = 0 * e^{-gt}$

=0+c

Y (t) =c/e^{-gt}

Y (t) =c*e^{gt}

Therefore , the general solution of Differential equation is y(t)=C*e^{gt}.

SECTORS OF INDIAN ECONOMY

India is rapidly growing large economy in the world, with a vast population, agreeable census and high catch-up potential due to layoffs and unemployment and declining business revenues and consumer spending.

Mainly, the Indian Gross Domestic Product(GDP)shares are shared by three sectors;

1.   **Agriculture and Allied Sector**:
Agriculture and allied sector are also called as Primary sector.
Primary sector of economy makes an effort to use the natural resources directly. Examples: Agriculture mining, Fishing, Forestry, Etc.
  Since most of natural products we get are from agriculture, forestry, fishing it's called as Agriculture and Allied sector.

2.   **Industry Sector:**
Industry sector is also known as Secondary sector. It contains the industries whose finished products are made from natural materials that are made in the primary sector.
Example: Industrial Production, Cotton Fabric, Sugarcane Production, Etc.
Since, this sector is associated with different types of industries it's called as Industrial sector.

3.   **Service Sector:**
Service sector is also named as tertiary sector .
Economic activities in tertiary sector do not produce the goods but they are an aid or support for the production.
   It upgrades the product identically as secondary sector. Example: Banking, Insurance, Finance, Transports, Etc.

INDIAN GDPCALCULATIONFORTHEFISCALYEAR2030

GDP of Indian Economy in 2021 is 2.94$ Trillion.
Percentage (%)Contributionofeachsectorin2021

SECTORS	SHAREin%
Service Sector	53.89%
Industry Sector	25.92%
Agriculture and allied Sector	20.19%

INDIANGDPCALCULATIONFORTHEFISCALYEAR2030:

GDP of Indian Economy in2021is2.94\$ Trillion. The Growth Rate of Indian Economy in 2030 will be 7-8%.

(SOURCE:WORLD BANK)

Solution:

The General solution to predict GDP using differential equation is,

$Y(t)= C*e^{gt}$ Where,

C-Current GDP of India C=2.94\$ Trillion,
g-Growth rate
g=8%
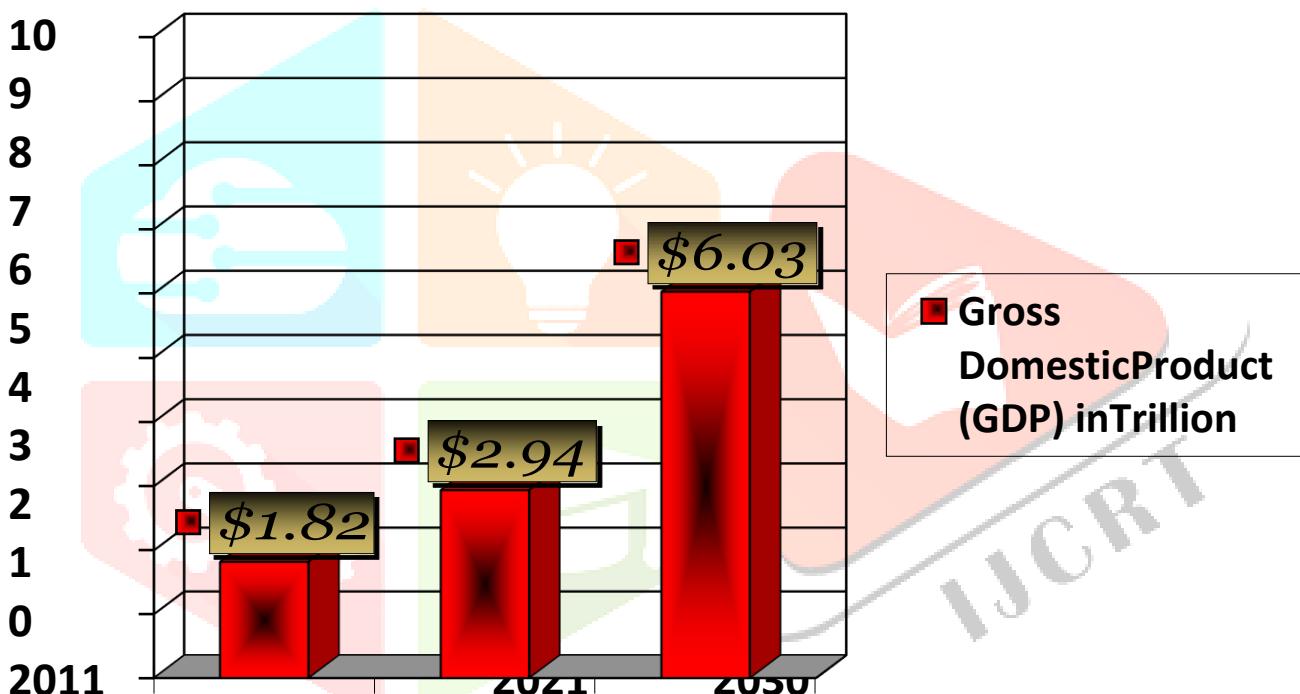t= Time period = 2030-2021= Years.
$Y(9)=2.94*e^{8/100*9}$
$Y(9)=2.94*e^{0.72}$
$Y(9) =2.94*2.054$
$Y(9)=6.03$TRILLION.

Graph of Indian Economy 2011 , 2021and 2030:

APPLICATIONOFMATHEMATICSINECONOMICS

II.   FUNCITONS:

Relationship between two or more variables can be described by mathematical function . A function expresses dependences of one variable on one or more other variables.

Y = f(x)

In economics demand is a function of price and production is a function of factors of production. D=f(p)

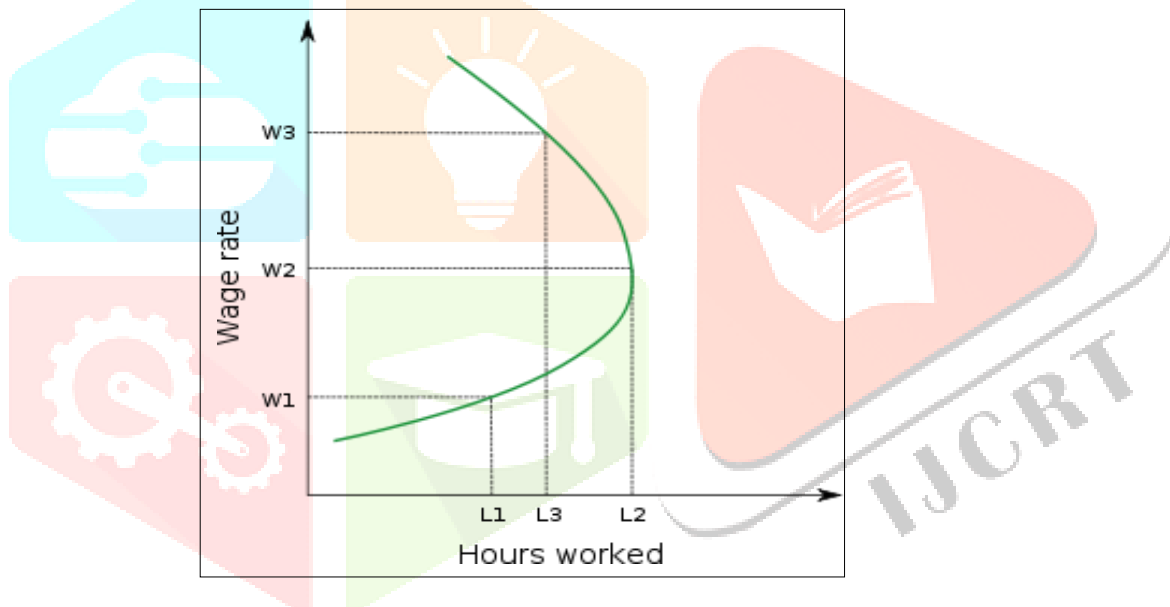This functional relationship is a mathematical concept. Similarly, supply junction of a commodity x is expressed as S=f(p)

Using the graph, we can show demand & supply,
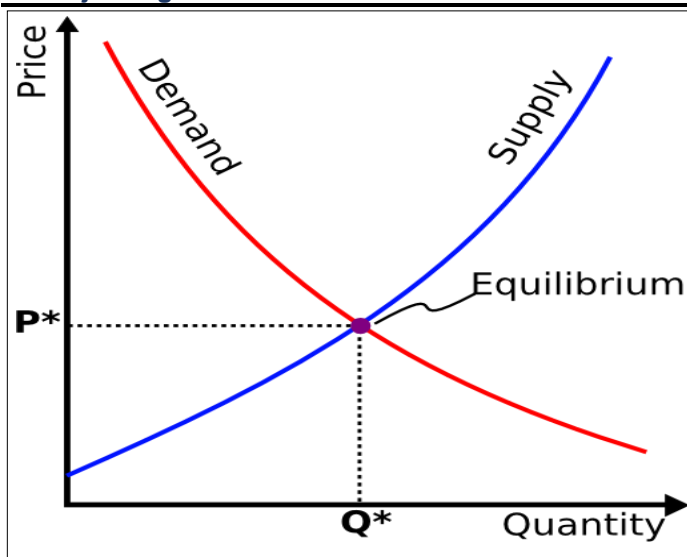
III.   PARABOLA:

A second-degree function or a Quadratic function is an additional mathematical concept. The graph of a second-degree function is a 'Parabola'(i.e.) U shaped.


In economics, it is used in cost functions, since cost curves in economics are U shaped. Quadratic functions are often used in economics to represent both cost function and revenue function.

IV.   DIFFERENTIATION:

Most economic decisions are based on mathematical concepts.' Derivatives' this process is called 'Marginal analyses. The basic concept in economics is the concept of 'margin'. The concept of 'marginal's' (marginal revenue, marginal profit, marginal cost) etc., is about the most important concept in microeconomics, because all decisions are taken at the margin. If the production is more your marginal revenue (MR) will fall & marginal cost (MC) t will rise so the profit can be maximized by producing. Where, MR=MC

V.   SLOPE:

The value of is the slope or gradient of a curve. Slope shows both steepness and direction. In economics, to find the slope of the curves like demand curves, revenue curves, cost curves, in difference curves. When slope is negative, the curve will be falling curve, if slope is positive, the curve will be rising one.
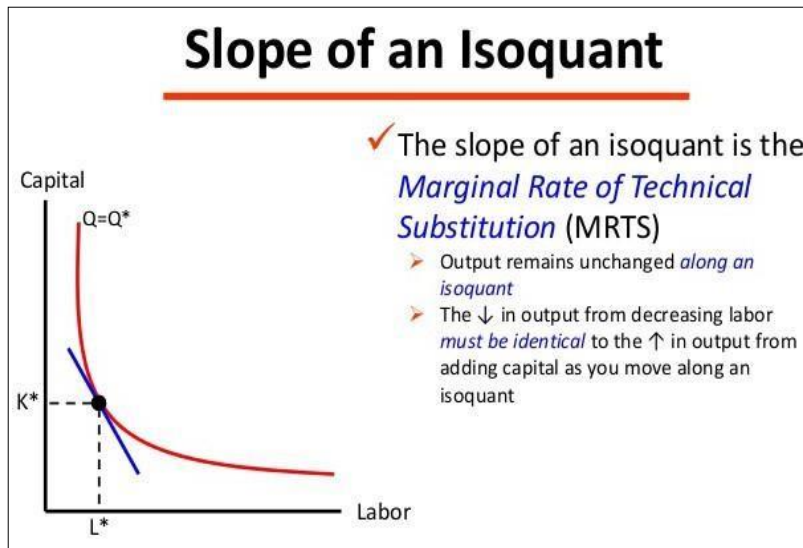
VI. DIFFERENTIALEQUATION:

They are used to determine the conditions for dynamic stability in micro economics model of market equilibrium. Trace the time path of growth under various conditions in micro economics. Differential equations provides the economist to determine the function whose growth is described, from point elasticity. They provides the economist to calculatee the demand function.
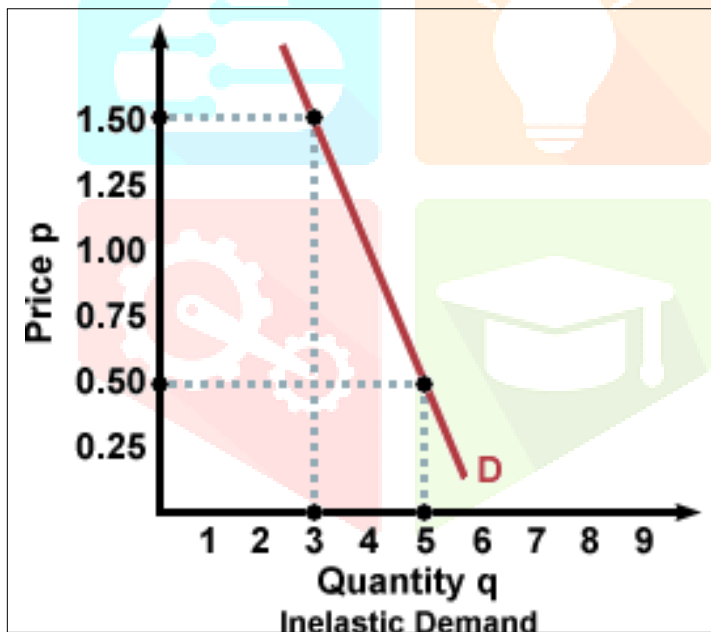
CONCLUSION

We have predicted Indian Gross Domestic Product(GDP) calculation for2030.Differential equation plays a vital role in Gross Domestic Product's (GDP)economic Growth rate. Differential equation is used in some fields of economics like, Gross Domestic Product (GDP), Share market and Business Management. Thus, Mathematics is a Tool to Economic Fields

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