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LALITPUR, NEPAL

A
LAB REPORT
ON

Simulation of National Econometric System

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SUBMITTED TO:

SIMULATION AND MODELLING

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OBJECTIVE:

1. To develop the mathematical modeling of the national econometric system.
2. To determine the state of the system at various fixed intervals of time using a distributed lag model.

THEORY

Models that have the properties of changing only at fixed intervals of time, and of basing current values of the variables on other current values and values that occurred in previous intervals, are called distributed lag models.
They are extensively used in economic studies where uniform steps correspond to a time interval, such as a month or a year, over which some economic data are collected. Such type of models consists of linear algebra. They represent a continuous system, but one in which the data is

$$C = 20 + 0.7(Y - T) \quad \text{.....(1)}$$
$$I = 2 + 0.1Y \quad \text{.....(2)}$$
$$T = 0.2Y \quad \text{.....(3)}$$
$$Y = C + I + G \quad \text{.....(4)}$$

Where,

C be consumption,
I be investment,
T be taxes,
G be government expenditure,
Y be national income,

This model can be made dynamic by picking a fixed time interval, say one year, and expressing the current values of the variables in terms of values at previous intervals. Any variables that appear in the form of its previous intervals are said to be a lagged variable. Its values in a previous interval are denoted by attaching the suffix –n to the variable, where n indicates the interval, with 1 denoting the previous interval. The static model can be made dynamic by lagging all the variables. To make the model dynamic, all the variable need not to be lagged so let one equation (1) express a single current variable in terms of lagged variable only. When this equation is solved, a second

equation, second equation can be solved that involves the current value just derived from the first equation can be solved and this process continue for next equations also. Using this principle, let us rearrange the equations above. Using the only one lagged variable Y i.e Y-1

Substituting the value of T and C in the original equation, the equation for Y is

$$Y = 45.45 + 2.27(I + G) \quad \text{.....(5)}$$

Similarly,

$$I = 2 + 0.1Y_{-1} \quad \text{.....(6)}$$

$$T = 0.2Y_{-1} \quad \text{.....(7)}$$

$$C = 20 + 0.7(Y_{-1} - T) \quad \text{.....(8)}$$

Since there are five unknown variables and only four equations, value of one variable must be provided, say given is G for each interval. By using the value of lagged variable $Y-1$, all the above equations can be solved. The calculations can then be repeated for the next interval of time.

SOURCE CODE FOR SIMULATION

Now I've used python programming language with framework numpy and matplotlib libraries to simulate the above mathematical model to determine the state of the system at various fixed intervals of time using a distributed lag, and visualize the results:

```
# Import Libraries

import numpy as np
import matplotlib.pyplot as plt

%matplotlib inline
```

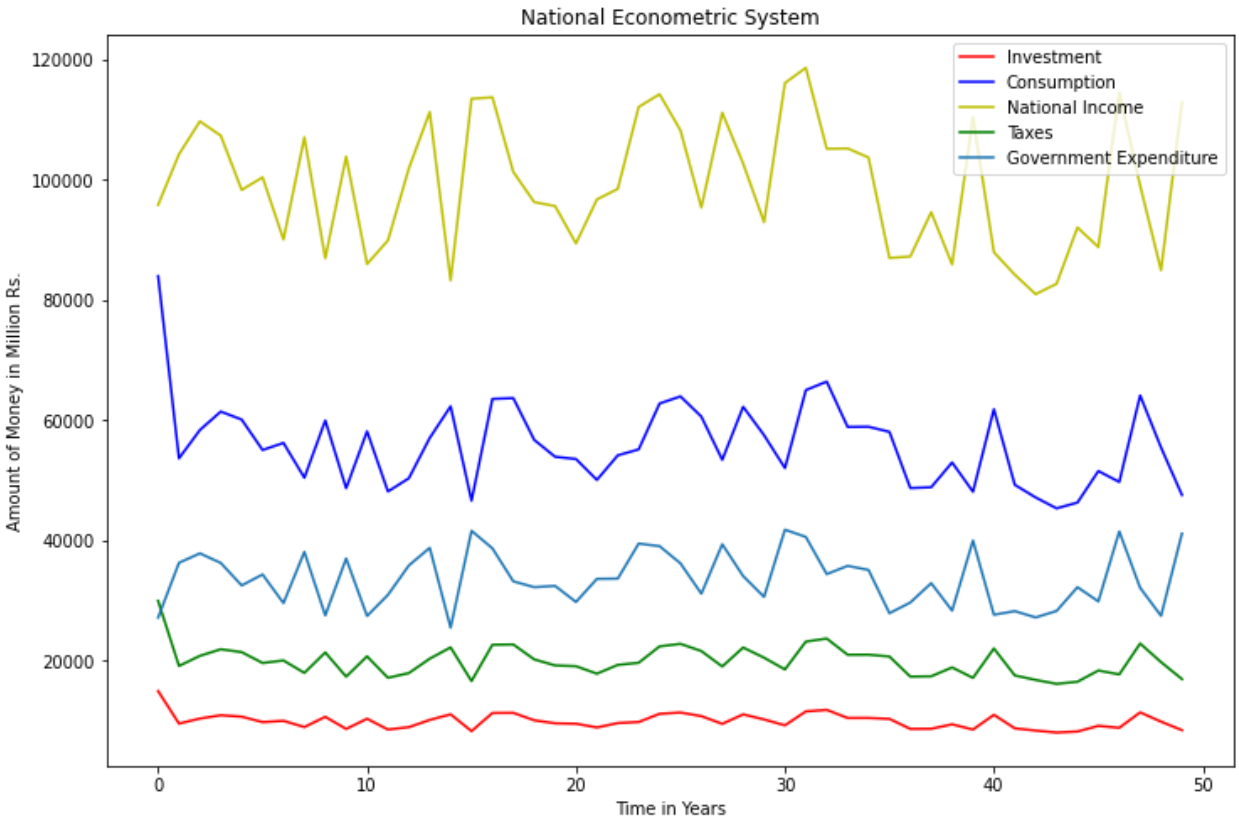
```
# Initialization


G = np.array([27210,36333,37902,36307,32567,34393,29630,38149,27590,37048,
              27486,31001,35886,38824,25541,41658,38738,33249,32281,32488,
              29820,33661,33704,39534,39101,36242,31193,39420,34123,30663,
              41841,40642,34452,35827,35153,27947,29723,32947,28379,40041,
              27700,28292,27243,28325,32278,29910,41544,32173,27511,41192
              ])

N = len(G)  # No of year
C = np.zeros(shape= (N))
I = np.zeros(shape= (N))
T = np.zeros(shape= (N))
Y = np.zeros(shape= (N))

Y[-1] = 150000
```

```
for i in range(0, N):
 I[i] = 2 + 0.1 * Y[i-1]
 Y[i] = 45.45 + 2.27 * (I[i] + G[i])
 C[i] = 20 + 0.7 * (Y[i] - T[i])
 T[i] = 0.2 * Y[i]
```

```
x = range(N)
plt.figure(figsize= (10, 6))
plt.plot(x, I, 'r', label= 'Investment')
plt.plot(x, C, 'b', label= 'Consumption')
plt.plot(x, Y, 'y', label= 'National Income')
plt.plot(x, T, 'g', label= 'Taxes')
plt.plot(x, G, 'v', label= 'Government Expenditure')
plt.legend()
plt.title('National Econometric System')
plt.xlabel('Time in Years')
plt.ylabel('Amount of Money in Million Rs.')
plt.show()
```

RESULT AND VISUALIZATION

After running the script, I obtained the following graph that shows the various values of Investment(I), Consumption(C), National Income(Y), and Taxes(T) for different values of Government Expenditure(G).



DISCUSSION AND CONCLUSION

In this lab, we constructed a distributed lag model of the national econometric system and simulated the progress for a period of 10 years using Python. After running the simulation, we obtained the above graph that shows the various values of Investment(I), Consumption(C), National Income(Y), and Taxes(T) for different values of Government Expenditure(G).