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Test Computational for The Analytical Estimate of the Epidemiological Infection Models with Control

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ABSTRACT*: We analyze the máximum number of infectad model. By means of a numerical simulation of the SIR mathematical model with the MATLAB software, the dynamics of the three components, especially of the infected ones, was estimated considering a step wise control. It has been observed the efective impact with the control on the three components especially for the infected has been detected a decrease. Analytical and computacional approaches can be used without any variation in the results. The Infected component may decrease with appropriate controls.*

KEYWORDS: *epidemic model with control; analytical estimates; simulation of differential equations*

I. INTRODUCTION

The most problem about the SIR model yields to be the handling of the maximum number of infected (1). Sebastian Pedersen has worked with analytic straight forward with respect to the maximum number of infected in the SIR (2) model.In the reference one work out with analytic argument the SIR model equations and one find there some relations for the maximum number of infected. There are many cases of epidemic in the daily life of the job more precisely of TBC such as one cite in (4). The standard control of inmigration generates mental epidemiological problems such as in (5). This paper has a goal justly carry out one comparative study between the analytical method and the other by computational method. All this one showing that both methods lead to the same results with respect to the maximum number of infected in the SIR epidemiological model and extending for the cases already controlled for one parameter of control that mainly stand for one strategy for containing the epidemic which in some cases it can be a program of vaccination. The optimal control would stay for the meta-knowledge part of this paper.

II. METHODOLOGY

Mathematical Model for The Ilness Contagious: Transmission-Infection : The SIR model consider a System of differential equations for analysing the dynamic susceptibles (S) standing for people that never have adquired the ilness whose amount is represented by q_S, Infected (I) or people that actually have the illness and can infect whose amount is represented by q_I and people recovered (R) that already had the ilness and including immune to infect. Whose amount is represented by q_R

$$\dot{q}_S = -K_{IS} q_I q_S$$

$$\dot{q}_I = K_{IS} q_I q_S - K_{RI} q_I$$

$$\dot{q}_R = K_{RI} q_I \qquad (1)$$

The constant K_{IS} is the coeficient of transmission and K_{RI} is the coeficient of recovery.

The classic method for the System of differential equations is applying the method of Runge –Kutta more precisely of fourth order and by using a computational straight forward with the software MATLAB.

For the time being one see the difference upon considering an intervention program of vaccination. This control is denoted by u(t) which make that the system (1) has some modifications with the term u(t).S. one add this term to the first equation with the minus sign: -u(t).S while the third term of the equation with the positive sign u(t).S.

III. RESULT AND DISCUSSION

Test of Simulation and Analytical Relations : The system of differential equations generate three solutions according to the figure 1. The figure 2 correspond with the second stage where apply the vaccination program within the five days of happened the epidemic.

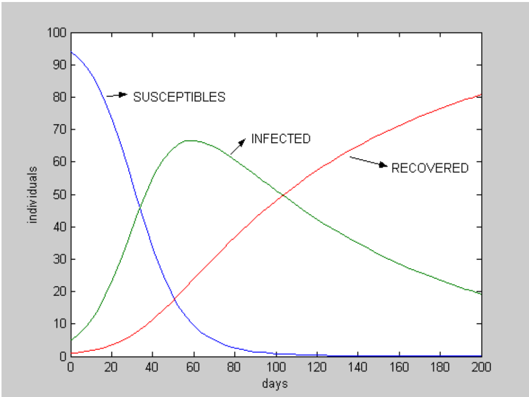

Figure 1. The solutions of the system (1) is applying the Runge-Kutta method with parameters K_{RI} =0.01, K_{IS}= 0.001 and

$q_I(0)$ =6 and N=99**; one make a point of the maximum number of infected is 69.**

In the figure 2 it has generated the solutions of the system (1) but the control term u(t) starting from t=5 days.

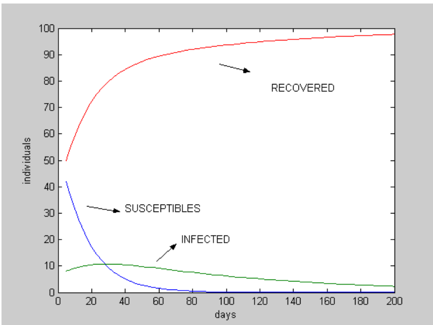

Figure 2. The solutions of the system (1) modified by the term u(t).S using the Runge-Kutta method with parameters K_{RI} =0.01, K_{IS}= 0.001 ,

$q_I(0)$ =6 and N=99**; one point out that the number of infected has greately decreased after of introducing the vaccine control u(t)=0.05.**

The analytical relations start from the integration by separation of variables and the relation with the N variables S, I, R (2). One obtain a relation for the maximum number of infected I MAXIMUM of the following type :

I MAXIMUM=N-ϱ**+**ϱ**ln(**ϱ / $q_s(0)$) (2)

By sustitution of the datas one obtain the value 67 that is precisely what it was obtained by computational method and visualize in the Figure 1:

N= 99

$\varrho = K_{RI}/K_{IS}$

$q_S(0) = 92$

we obtain the value:

I Maximum=67

The relation (2) can be saw in detail more precisely in the reference (2) of Sebastian Petersen where the value of the parameter ϱ is the quotient between the coefficient of transmission.

III. CONCLUSION

We demonstrate that the computational simulation of SIR model for the infection maximum is approximately the analytical estimation.

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