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Various Type of HIV Infected Virus

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ABSTRACT

In this paper, we have reviewed the equation of human immune deficiency virus (HIV) delayed model with cure of infected cells in the eclipse phase described by ordinary differential equation (ODE).In addition we obtain the graph showing the stages of healthy cells ,infected cells but not spread the virus, and infected cells spreading the virus and virus cells by using MATLAB and successive approximation method.

Keywords : HIV, MATLAB, Successive Approximation Method

I. INTRODUCTION

The purpose of this work is to investigate the dynamical behavior of the following HIV infection model governed by the ordinary differential equation model which given by

$\frac{dH}{dt}$=$\mu - \lambda_H$H(t)-f(H(t),R(t))R(t)+$\rho L(t)$

$\frac{dL}{dt}$= f(H(t),R(t))R(t)-(λ_L+$\rho + \gamma$)L(t)

$\frac{dN}{dt}$= $\gamma L(t)$- λ_NN(t)

$\frac{dR}{dt}$=P$e^{-m\tau}$N(t-τ)-λ_RR(t) (1)

The first equation of (1) describes the dynamics of the concentration of healthy cells (H). μ is the recruitment rate and λ_H is the death rate of uninfected cells. During infection ,healthy cells decreases proportionally to the product f(H,R)R. The second equation represents the dynamics of the concentration of the infected cells in eclipse stage.(i.e) infected that are not yet producing virus. λ_L is a die at rate , ρ is a productive rate infected cells .The third equation represents dynamics of the concentration productive infected cells N. λ_N is a dieing rate. The last equation represents dynamics of the concentration of viruses which are produced by infected cells at the rate P, λ_R is a dieing a rate. The delay τ describes the time needed for productive infected cells which are produced virions and $e^{-m\tau}$ is the probability of surviving from time (t-τ) to time t
The model is disease transmission process by hattaf's incidence rate

F(N,R)=$\frac{\alpha N}{1+\delta_1 N+\delta_2 R+\delta_3 NR}$

Where $\delta_1, \delta_2, \delta_3 \leq 0$ are constants and α is the infection rate.

II. BASIC RESULTS

We can easily show that there exits a unique solution (H(t),L(t),N(t),R(t)) for equation (1) initial condition (H_0, L_0, N_0, R_0) for a biological reason we assume this condition to satisfy

$H_0(m) \leq 0, L_0(m) \leq 0, N_0(m) \leq 0, R_0(m) \leq 0$
for m∈ $(-\tau, 0)$ (2)

THEOREM.2.1:

The solution of equation (1) satisfying condition (2) remains non negative and bounded for all t≤0

Proof:

It is easy way to show that non negative of the solution of system (1) with initial condition satisfying (2).show that the boundedness of solution

We define

A(t) = H(t) + L(t) +N(t)

$= \mu - \lambda_H$ H(t)-f(H(t),R(t))R(t)+ $\rho L(t) +$ $f(H(t), R(t))R(t) - (\lambda_L + \rho + \gamma)L(t) + \gamma L(t)$ - λ_NN(t)

$= \mu - \lambda_H$ H(t)-f(H(t),R(t))R(t)+ $\rho L(t) +$ $f(H(t), R(t))R(t) - \lambda_L L(t) - \rho L(t) - \gamma L(t) +$ $\gamma L(t)$- λ_NN(t)

$= \mu - \lambda_H$H(t) $-\lambda_L$L(t) - λ_NN(t)

$\frac{dA}{dt} = \mu - \lambda_H$H(t) $-\lambda_L$L(t) - λ_NN(t)

$\geq \mu - \lambda A(t)$

Where $\lambda = \max(\lambda_H, \lambda_L, \lambda_N)$

Here A(t) $\geq \min\{A(0), \frac{\mu}{\lambda}\}$

Therefore H(t),L(t),N(t),R(t) are bounded.

Other hand

$\frac{dR}{dt}$ = P$e^{-m\tau}$N(t-τ)-λ_RR(t)

$\geq$ P$e^{-m\tau}\|N\|_\infty$-λ_RR(t)

R(t)=min{R(0),$\frac{Pe^{-m\tau}}{\lambda_R}\|N\|_\infty$}

We define R(t) is bounded

Graph for showing stages of healthy cells , infected cells but not spread the virus, and infected cells spreading the virus and virus cells by using MATLAB and successive approximation method.

1.HEALTHY CELLS:

H'=H,H(0)=1

H'=f(s,H(s))

$H_0 = 1$ when t_0=0

H_{n+1}=H_0+$\int_{t_0}^{t} f(s, H_n$(s))ds

When n=0

$H_1 = H_0 + \int_{t_0}^{t} H_0$dt

=H_0+$[s]_0^t$

H_1(t)=1+t

H_2=H_0+$\int_{t_0}^{t} f(s, H_1(s))$ds

=1+$\int_{t_0}^{t}(1+s)$ds

=1+[t+$\frac{t^2}{2}$]

$H_n(t)$=1+t+$\frac{t^2}{2}$

SUCCESSIVE APPROXIMATION METHOD BY USING MATLAB CODING

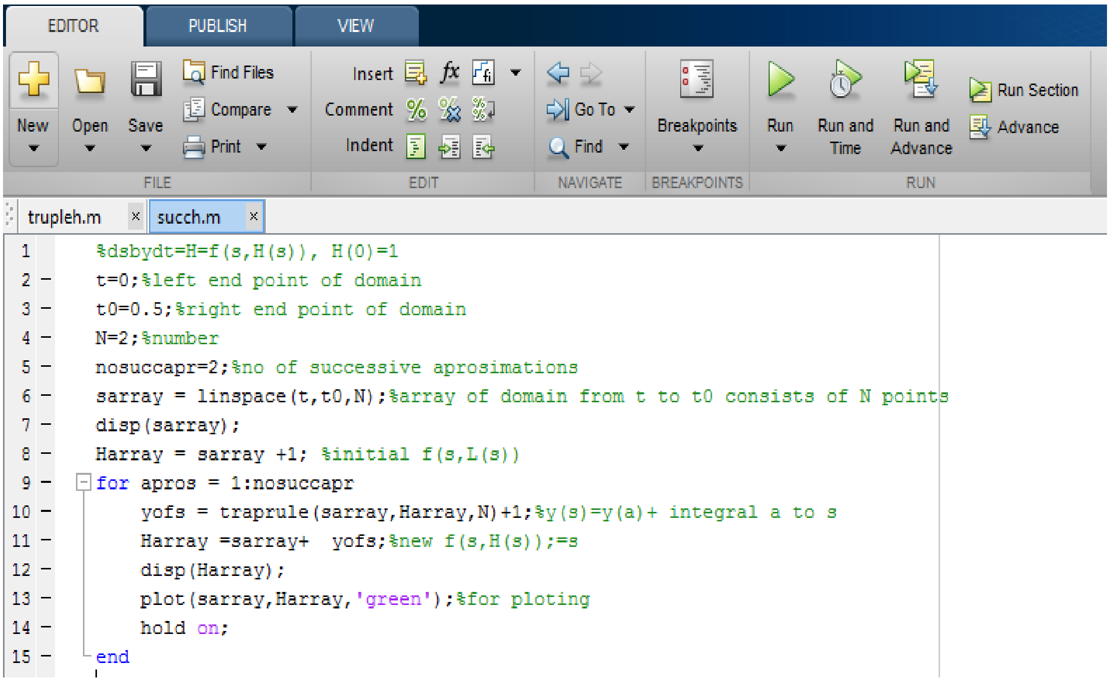


Figure 1

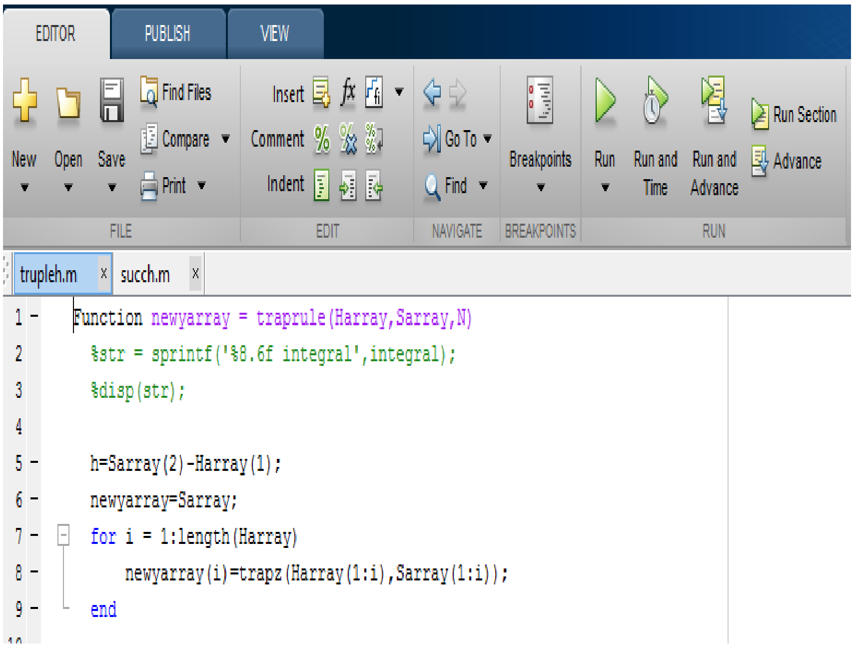


Figure 2

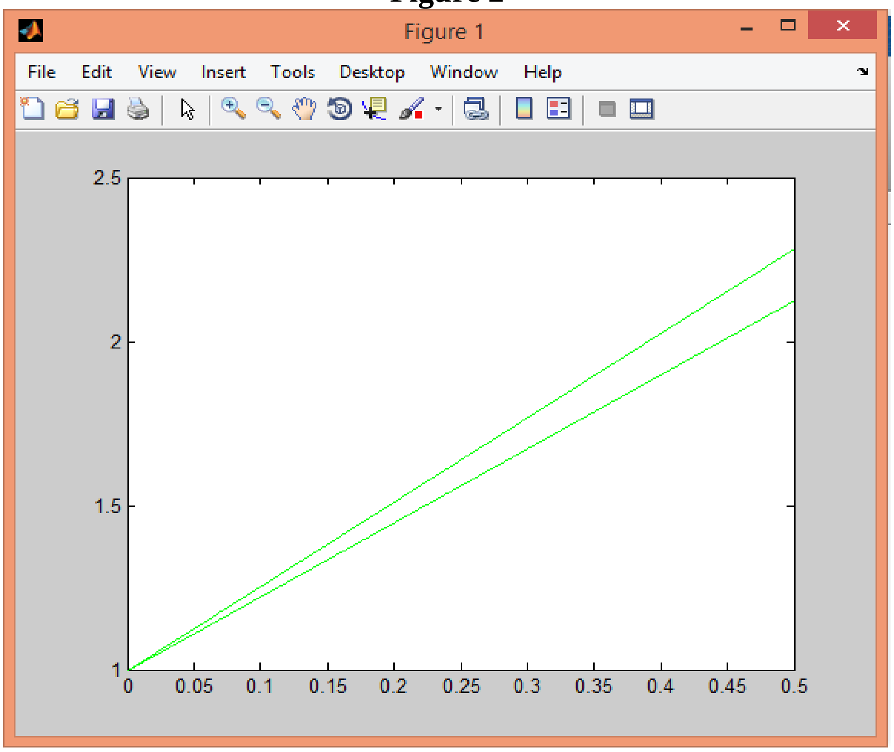


Figure 3

2.INFECTED CELLS BUT NOT YET PRODUCING VIRUS:

L'=L,L(0)=1

L'=f(s,L(s))

$L_0 = 2$ when t_0=1

L_{n+1}=L_0+$\int_{t_0}^{t} f(s, L_n(s))$ds

When n=1

$L_1 = L_0 + \int_{t_0}^{t} L_0$dt

=2+$[s]_1^t$

=2+[t-1]

L_1(t)=1+t

L_2=L_0+$\int_{t_0}^{t} f(s, L_1(s))$ds

=2+$\int_{t_0}^{t}(1+s)$ds

=2+$[s+\frac{s^2}{2}]_{t_0}^{t}$

=2+$[s+\frac{s^2}{2}]_1^t$

=2+[(t+$\frac{t^2}{2}$)-(1+$\frac{1}{2}$)]

$$=2+[\ t+\frac{t^2}{2}+\frac{3}{2}]$$

$$L_n(t)=t^2+2t-\frac{1}{2}$$

SUCCESSIVE APPROXIMATION METHOD BY USING MATLAB CODING

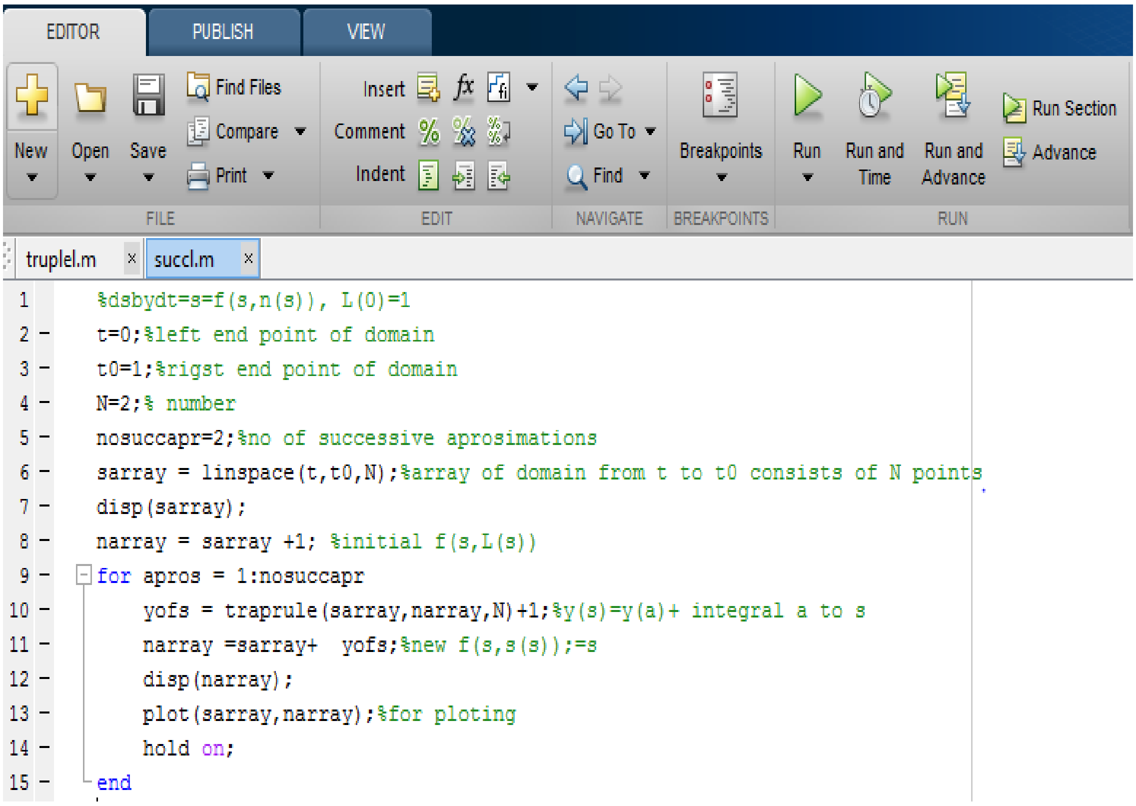


Figure 4

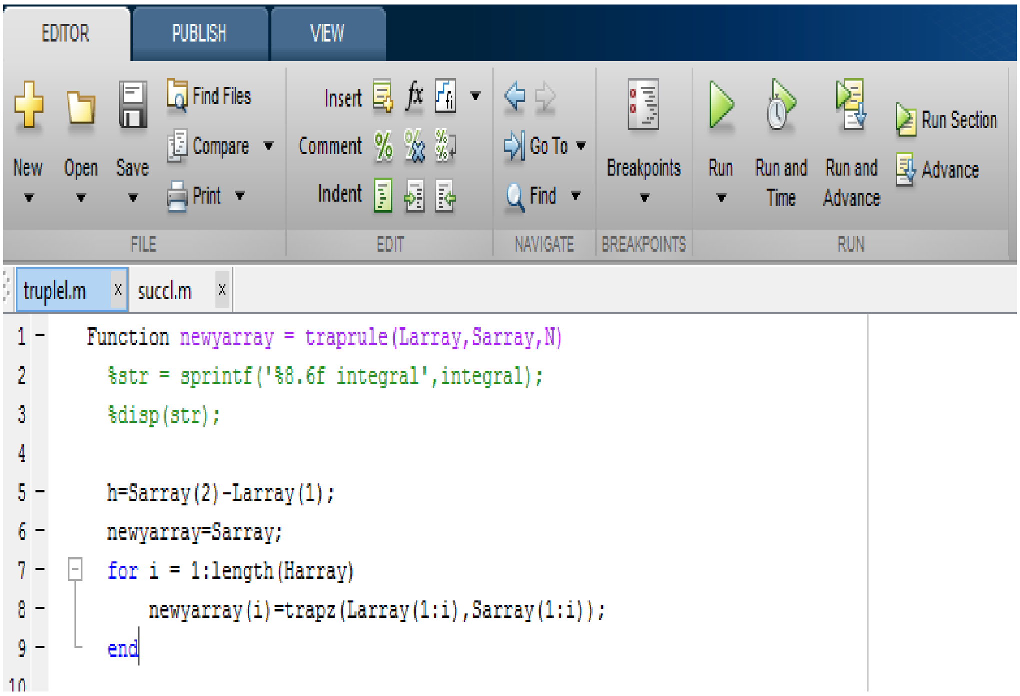


Figure 5

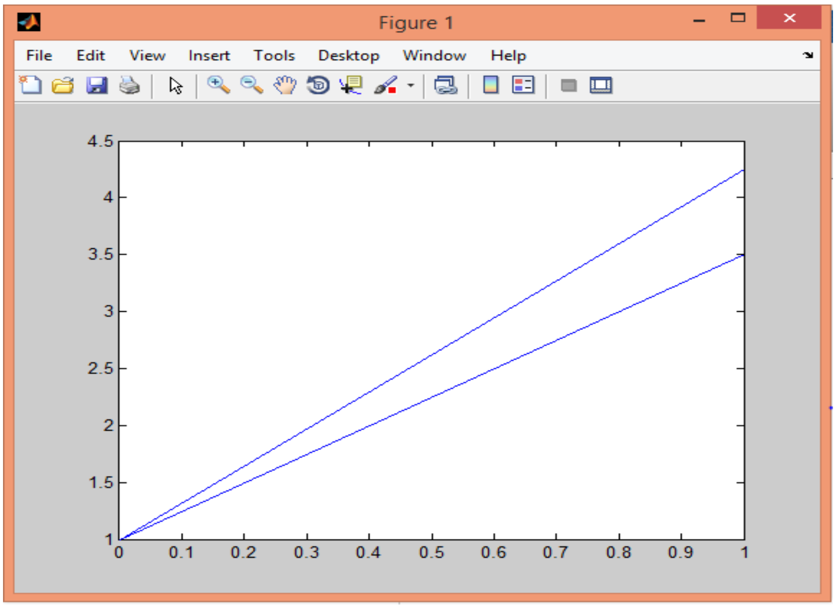


Figure 6

3. INFECTED CELLS SPREADS THE VIRUS:

N'=N,N(0)=1

N'=f(s,N(s))

$N_0 = 3$ when t_0=2

N_{n+1}=L_0+$\int_{t_0}^{t} f(s, N_n(s))$ds

When n=1

$N_1 = N_0 + \int_{t_0}^{t} N_0$dt

=3+$[s]_2^t$

=3+[t-2]

N_1(t)=1+t

N_2=N_0+$\int_{t_0}^{t} f(s, N_1(s))$ds

=3+$\int_{t_0}^{t}(1+s)$ds

=3+$[s+\frac{s^2}{2}]_{t_0}^{t}$

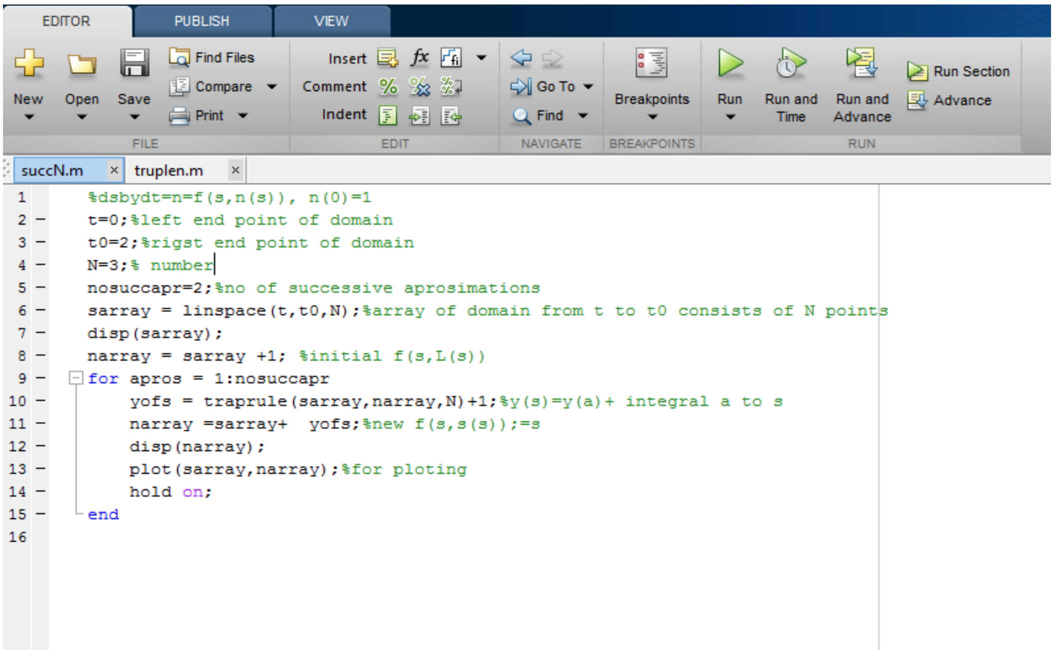
=3+$[s+\frac{s^2}{2}]_2^t$

=3+$[(t+\frac{t^2}{2})-(2+\frac{4}{2})]$

=3+$[\frac{2t+t^2-8}{2}]$

$N_n(t)$= $[\frac{t^2+2t-2}{2}]$

SUCCESSIVE APPROXIMATION METHOD BY USING MATLAB CODING




```
%dsbydt=n=f(s,n(s)), n(0)=1
t=0;%left end point of domain
t0=2;%rigst end point of domain
N=3;% number
nosuccapr=2;%no of successive aprosimations
sarray = linspace(t,t0,N);%array of domain from t to t0 consists of N points
disp(sarray);
narray = sarray +1; %initial f(s,L(s))
for apros = 1:nosuccapr
    yofs = traprule(sarray,narray,N)+1;%y(s)=y(a)+ integral a to s
    narray =sarray+  yofs;%new f(s,s(s));=s
    disp(narray);
    plot(sarray,narray);%for ploting
    hold on;
end
```

Figure 7

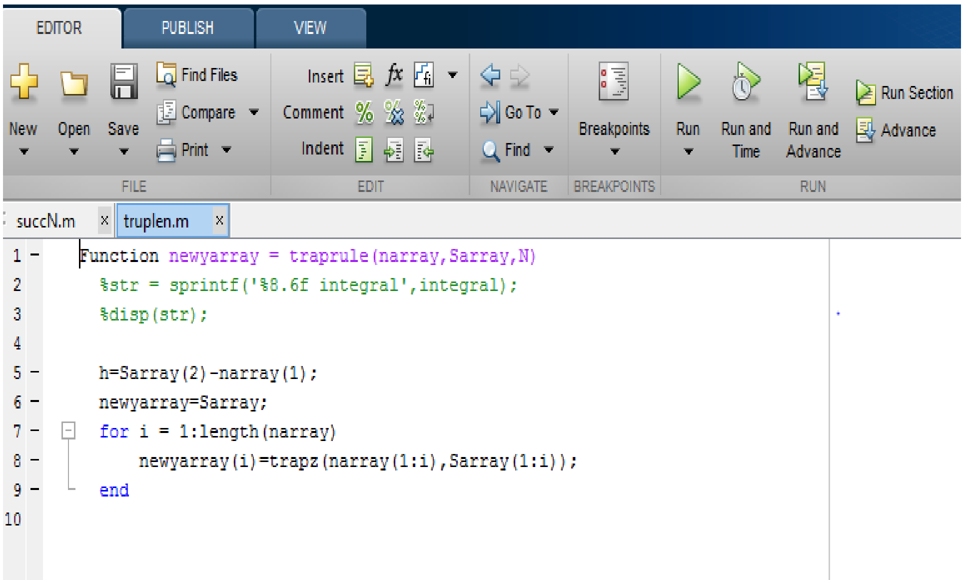


Figure 8

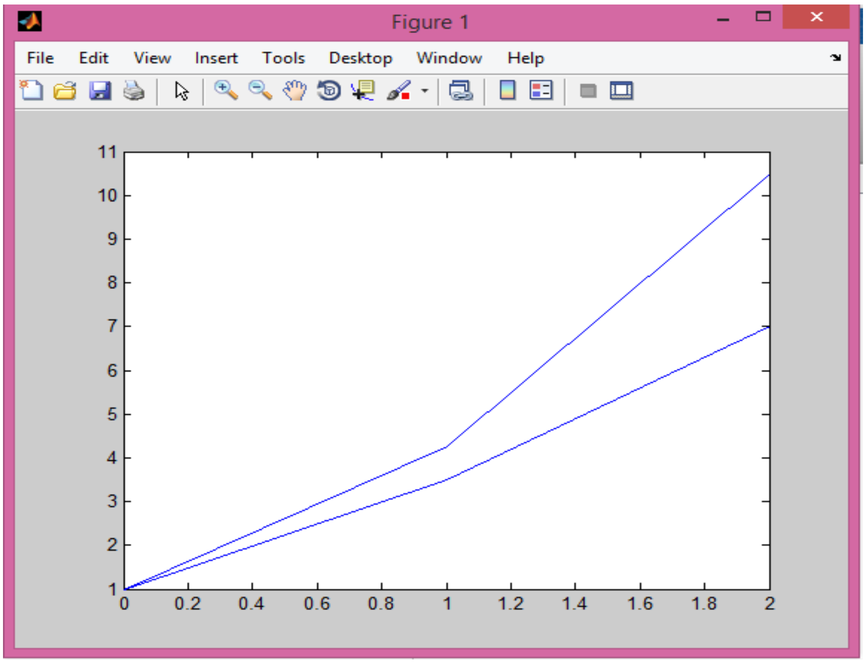


Figure 9

4.VIRUS CELLS;

R'=R,R(0)=1

R'=f(s, R(s))

$R_0 = 4$ when t_0=3

N_{n+1}=L_0+$\int_{t_0}^{t} f(s, N_n(s))$ds

When n=1

$R_1 = R_0 + \int_{t_0}^{t} R_0$dt

=4+$[s]_3^t$

=4+[t-3]

R_1(t)=1+t

R_2=R_0+$\int_{t_0}^{t} f(s, R_1(s))$ds

=4+$\int_{t_0}^{t}(1+s)$ds

=4+$[s+\frac{s^2}{2}]_{t_0}^{t}$

=4+$[s+\frac{s^2}{2}]_{3}^{t}$

=4+[(t+$\frac{t^2}{2}$)-(3+$\frac{9}{2}$)]

=4+[$\frac{t^2+2t-15+8}{2}$]

$R_n(t)$= [$\frac{t^2+2t-7}{2}$]

SUCCESSIVE APPROXIMATION METHOD BY USING MATLAB CODING

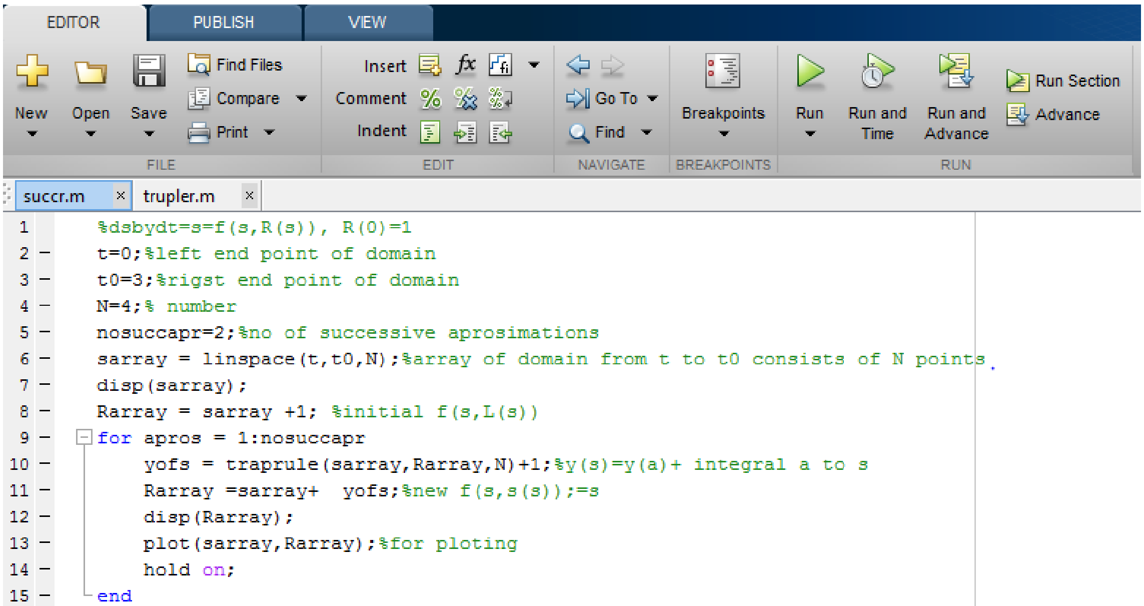


Figure 10

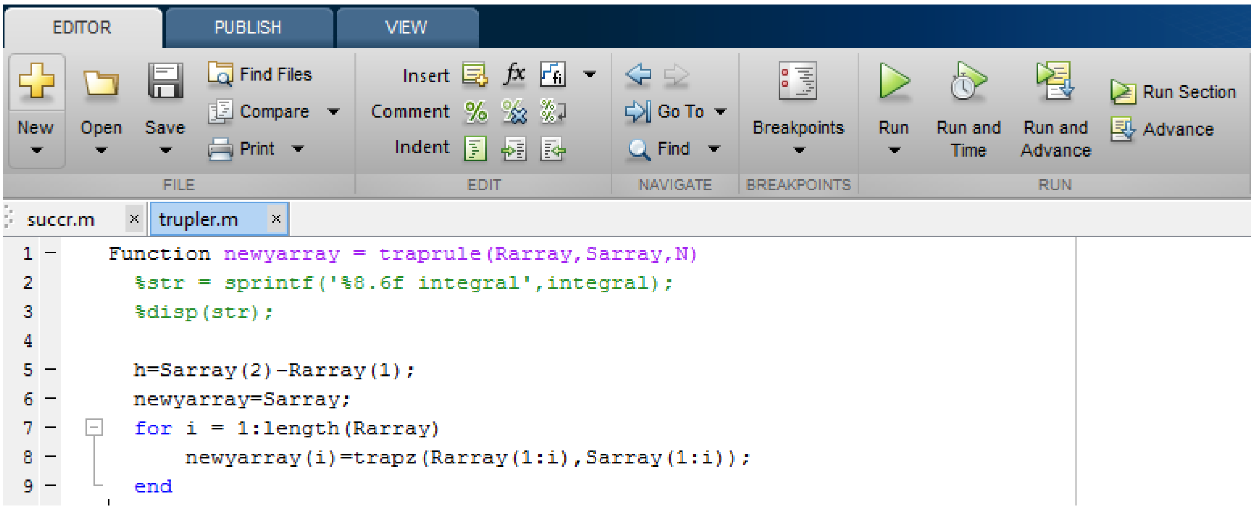


Figure 11

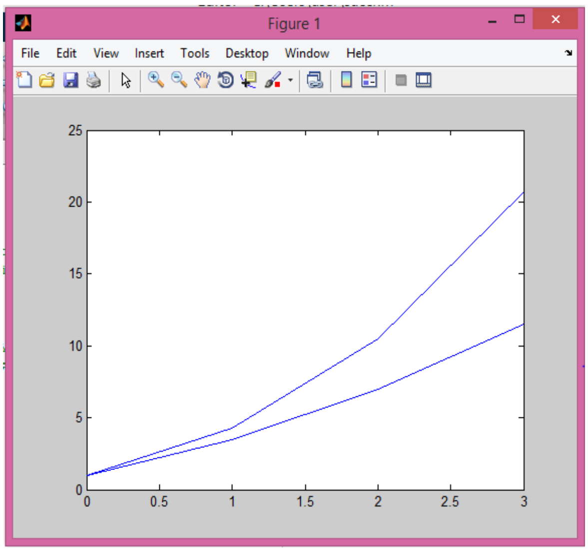


Figure 12

III. CONCLUSION

In this paper we showed the graph of various types of infected cells that produce virus. In this we used the MATLAB Program and successive approximation method and hence we formulated graph.

IV. REFERENCES

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