

Matlab code for all Figures

M-File for Rabies Model (figure 3 (a & b))

```
function dy = Rabies Model ( t,y )
dy=zeros(size(y));
bettas=0.0000129;
theta=0.50;
A=30,000;
A=25,000;
A=20,000;
A=15,000;
% use Different Annual birth
alpha=0.5;
nu=0.083;
c_p=0.5;
c_f=0.5;
epsilon=1;
row=0.821;
delta=0.17;
N=y(1)+y(2)+y(3)+y(4)+y(5);
dy(1)=A-bettas*(y(3)+y(4))*y(1)-(theta+nu)*y(1)+alpha*y(5);
dy(2)=bettas*(y(3)+y(4))*y(1)-(delta+nu)*y(2);
dy(3)=delta*y(2)-(row+c_p+nu)*y(3);
dy(4)=row*y(3)-(epsilon+c_f+nu)*y(4);
dy(5)=theta*y(1)-(alpha+nu)*y(5);
dy=[dy(1) dy(2) dy(3) dy(4) dy(5)]';
R0=(A*bettas*delta*(epsilon+c_p+nu+row))/((nu*(theta+alpha+nu)*(
delta+nu)*(row+c_p+nu)*(epsilon+c_f+nu)))
end
```

Scripts Used in Calling the M-Files for Rabies Models (figure 3 a & b)

```
function [t,y]=Rabies Modelsc;
[t,y]=ode45(@Rabies Model,[0,40],[300000 8000 150 250 50000]);
legend('A=30,000','A=25,000','A=20,000','A=15,000');
%figure 3(a)
xlabel('time in year','FontSize',12);ylabel('Infected (in
prodromal Phase)','FontSize',12)
plot(t,y(:,3),'r-','LineWidth',2);
hold on
plot(t,y(:,3),'g-','LineWidth',2);
hold on
plot(t,y(:,3),'b-','LineWidth',2);
hold on
plot(t,y(:,3),'k-','LineWidth',2);
end
%figure 3(b)
xlabel('time in year','FontSize',12);ylabel('Infected (in
Forious Phase)','FontSize',12)
plot(t,y(:,4),'r-','LineWidth',2);
```

```

hold on
plot(t,y(:,4),'k-','LineWidth',2);
hold on
plot(t,y(:,4),'b-','LineWidth',2);
hold on
plot(t,y(:,4),'g-','LineWidth',2);
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

```

M-File for Rabies Model (figure 4 (a & b))

```

function dy = Rabies Model ( t,y )
dy=zeros(size(y));
bettas=0.0000129;
A=20,000;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
theta=0.00;
c_p=0.00;
c_f=0.00;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
theta=0.50;
c_p=0.00;
c_f=0.00;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
theta=0.00;
c_p=0.50;
c_f=0.50;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
theta=0.50;
c_p=0.50;
c_f=0.50;
% use Different Culling & Vaccination rate
alpha=0.5;
nu=0.083;
c_p=0.5;
c_f=0.5;
epsilon=1;
row=0.821;
delta=0.17;
N=y(1)+y(2)+y(3)+y(4)+y(5);
dy(1)=A-bettas*(y(3)+y(4))*y(1)-(theta+nu)*y(1)+alpha*y(5);
dy(2)=bettas*(y(3)+y(4))*y(1)-(delta+nu)*y(2);
dy(3)=delta*y(2)-(row+c_p+nu)*y(3);
dy(4)=row*y(3)-(epsilon+c_f+nu)*y(4);
dy(5)=theta*y(1)-(alpha+nu)*y(5);
dy=[dy(1) dy(2) dy(3) dy(4) dy(5)]';
R0=(A*bettas*delta*(epsilon+c_p+nu+row))/((nu*(theta+alpha+nu)*(
delta+nu)*(row+c_p+nu)*(epsilon+c_f+nu))
end

```

Scripts Used in Calling the M-Files for Rabies Models (figure 4 a & b)

```
function [t,y]= Rabies Modelsc;
[t,y]=ode45(@Rabies Model,[0,40],[300000 8000 150 250 50000]);
legend('No intervention', 'only 50% vaccination', 'only 50%
culling', '50% vaccination and 50% culling');
%figure 4 (a)
xlabel('time in year','FontSize' ,12);ylabel('Infected (in
prodromal Phase)','FontSize' ,12)
plot(t,y(:,3),'r-','LineWidth',2);
hold on
plot(t,y(:,3),'g-','LineWidth',2);
hold on
plot(t,y(:,3),'k-','LineWidth',2);
hold on
plot(t,y(:,3),'b-','LineWidth',2);
end
%figure 4 (b)
xlabel('time in year','FontSize' ,12);ylabel('Infected (in
Forious Phase)','FontSize' ,12)
plot(t,y(:,4),'k-','LineWidth',2);
hold on
plot(t,y(:,4),'r-','LineWidth',2);
hold on
plot(t,y(:,4),'b-','LineWidth',2);
hold on
plot(t,y(:,4),'g-','LineWidth',2);
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

M-File for Rabies Model (figure 5 (a & b))

```
function dy = Rabies Model ( t,y )
dy=zeros(size(y));
bettas=0.0000129;
theta=0.0;
theta=0.2;
theta=0.4;
theta=0.6
% use Different Vaccination rate
A=20000;
alpha=0.5;
nu=0.083;
c_p=0.5;
c_f=0.5;
epsilon=1;
row=0.821;
delta=0.17;
N=y(1)+y(2)+y(3)+y(4)+y(5);
dy(1)=A-bettas*(y(3)+y(4))*y(1)-(theta+nu)*y(1)+alpha*y(5);
dy(2)=bettas*(y(3)+y(4))*y(1)-(delta+nu)*y(2);
```

```

dy(3)=delta*y(2)-(row+c_p+nu)*y(3);
dy(4)=row*y(3)-(epsilon+c_f+nu)*y(4);
dy(5)=theta*y(1)-(alpha+nu)*y(5);
dy=[dy(1) dy(2) dy(3) dy(4) dy(5)]';
R0=(A*bettas*delta*(epsilon+c_p+nu+row))/((nu*(theta+alpha+nu)*(delta+nu)*(row+c_p+nu)*(epsilon+c_f+nu)))
end

```

Scripts Used in Calling the M-Files for Rabies Models (figure 5 a & b)

```

function [t,y]= Rabies Modelsc;
[t,y]=ode45(@Rabies Model,[0,40],[300000 8000 150 250 50000]);
legend('No Vaccination','20% Vaccination','40% Vaccination','60% Vaccination');
%figure 5 (a)
xlabel('time in year','FontSize' ,12);ylabel('Susceptible Dogs','FontSize' ,12)
plot(t,y(:,1),'r-','LineWidth',2);
hold on
plot(t,y(:,1),'k-','LineWidth',2);
hold on
plot(t,y(:,1),'g-','LineWidth',2);
hold on
plot(t,y(:,1),'b-','LineWidth',2);
end
%figure 5 (b)
xlabel('time in year','FontSize' ,12);ylabel('Recover Dogs','FontSize' ,12)
plot(t,y(:,5),'b-','LineWidth',2);
hold on
plot(t,y(:,5),'k-','LineWidth',2);
hold on
plot(t,y(:,5),'g-','LineWidth',2);
hold on
plot(t,y(:,5),'r-','LineWidth',2);
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

```

Matlab code for Figure 2 (sensitive Analysis)

```

senv=[1 1 -1.457518442 -0.4616805171 -0.6317119394 -0.2157385617
-0.1481386673 -0.3158559697 0.3280632411 -0.2432436917];
names=categorical({'\sigma','\beta','\mu','\theta','\alpha','\epsilon',
'C_P','C_F','\delta','\rho'});
%yticklabels({'\sigma','\beta','\mu','\theta','\alpha','\epsilon',
', 'C_P','C_F','\delta','\rho'})
barh(names,senv,'m')
xlabel('Sensitivity indices of \Re_{e}')
ylabel('Basic Parameters')
set(gca,'linewidth',2.8)
%yticklabels({'April','May','June','July'})

```