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```

%Initial Conditions:
S_0 = 1000; % Susceptible
I_0=1; % Infected
R_0=0; % Recovered
N = S_0+ I_0 + R_0;
b=100; % birth rate into susceptible
D=0.1; % death rate (independent of disease)

%vaccTime = 100;
%endTime = 150;
%T1 = 0:vaccTime;
%T2 = vaccTime:endTime;
T2 = 0:150; % Time

nu=0.2; % Recovery rate
beta=0.0004; % Transmission rate
det=0.5

det =

    0.5000

```

## 0:100 - pre vaccination

```

[t, class]=ode45(@(t, class) simpModDet(t, class, N, beta, nu, b, D,
    det), T2,[S_0 I_0 R_0]);
S=class(:,1);
I=class(:,2);
R=class(:,3);

```

## 100:150 - post vaccination

```

DetVec=[1, 0.5, 0.11, 0.09, 0.009, 0.0009,0.0001, 0];
Names=string(DetVec);
n = length(DetVec);
figure
for i = 1:n
    det = DetVec(i);
    sigma=0.5;
    deltaI=0.2;
    [t, class2]=ode45(@(t, class) simpModDet(t, class, N, beta, nu, b,
D, det), T2, class(size(class,1),:));
    S=class2(:,1);
    I=class2(:,2);
    R=class2(:,3);

    subplot(0.5*n,2,i)
    pl=plot(t,S,'g','LineWidth',2); hold on

```

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```

p2=plot(t,I,'r','LineWidth',2); hold on
p3=plot(t,R,'b','LineWidth',2); hold on
%axis([0 150 0 3000])
ylabel('Incidence')
title(sprintf('$d_{k}= %s',Names{i}),'Interpreter','latex', 'FontSize', 12, 'FontName', 'Times New Roman');
R_nought=(beta*b)/(D*(D + nu + det));
text(65,max(S)*0.8,sprintf('$R_{0}= %.4f',R_nought),'Interpreter','latex', 'FontSize', 12, 'FontName', 'Times New Roman')
grid on
end
suplabel('Years')
hL = legend([p1,p2,p3],{'Susceptible (S)', 'Infected (I)', 'Recovered (R)'}, 'Orientation', 'horizontal');
newPosition = [0.4 0.87 0.2 0.2];
newUnits = 'normalized';
set(hL,'Position', newPosition,'Units', newUnits, 'color','none','Box','off');

```

*ans =*

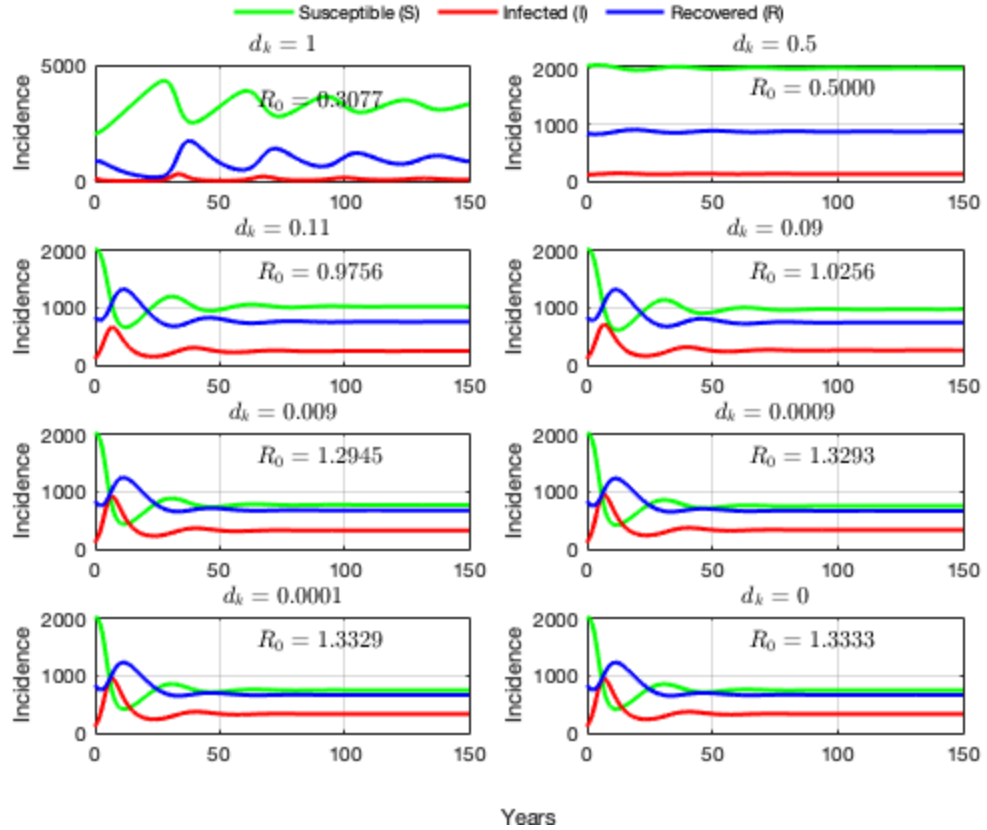
*Axes (suplabel) with properties:*

```

        XLim: [0 1]
        YLim: [0 1]
        XScale: 'linear'
        YScale: 'linear'
    GridLineStyle: '-'
        Position: [0.0900 0.0700 0.8550 0.8950]
        Units: 'normalized'

```

*Use GET to show all properties*



```

DetVec=[1, 0.5, 0.11, 0.09, 0.009, 0.0009,0.0001, 0];
Names=string(DetVec);
n = length(DetVec);
figure
for i = 1:n
    det = DetVec(i);
    sigma=0.5;
    deltaI=0.2;
    [t, class2]=ode45(@(t, class) simpModDet(t, class, N, beta, nu, b,
D, det), T2, class(size(class,1),:));
    S=class2(:,1);
    I=class2(:,2);
    R=class2(:,3);

    %p1=plot(t,S,'g','LineWidth',2); hold on
    p2=plot(t,I,'r','LineWidth',2); hold on
    %p3=plot(t,R,'b','LineWidth',2); hold on
    %axis([0 150 0 3000])
    ylabel('Incidence')
    grid on
end
suplabel('Years')
hL = legend([p1,p2,p3],{'Susceptible (S)', 'Infected (I)', 'Recovered
(R)'}, 'Orientation', 'horizontal');
newPosition = [0.4 0.87 0.2 0.2];
newUnits = 'normalized';

```

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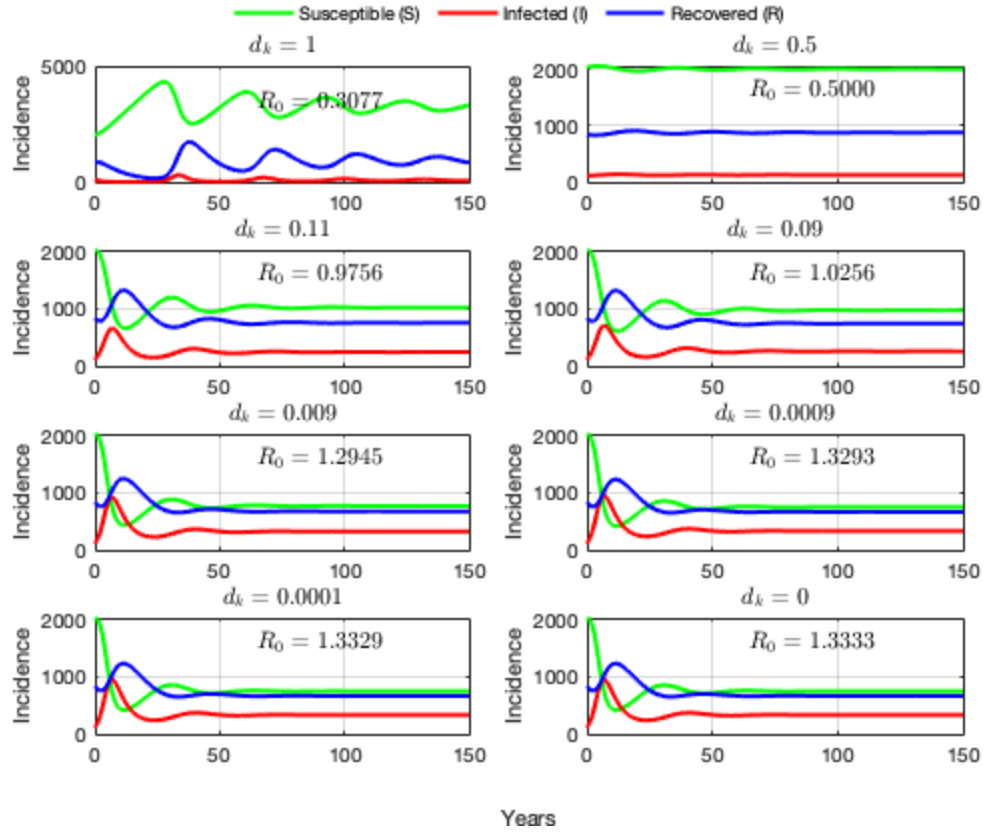
```
set(hL,'Position', newPosition,'Units',
    newUnits, 'color','none','Box','off');
```

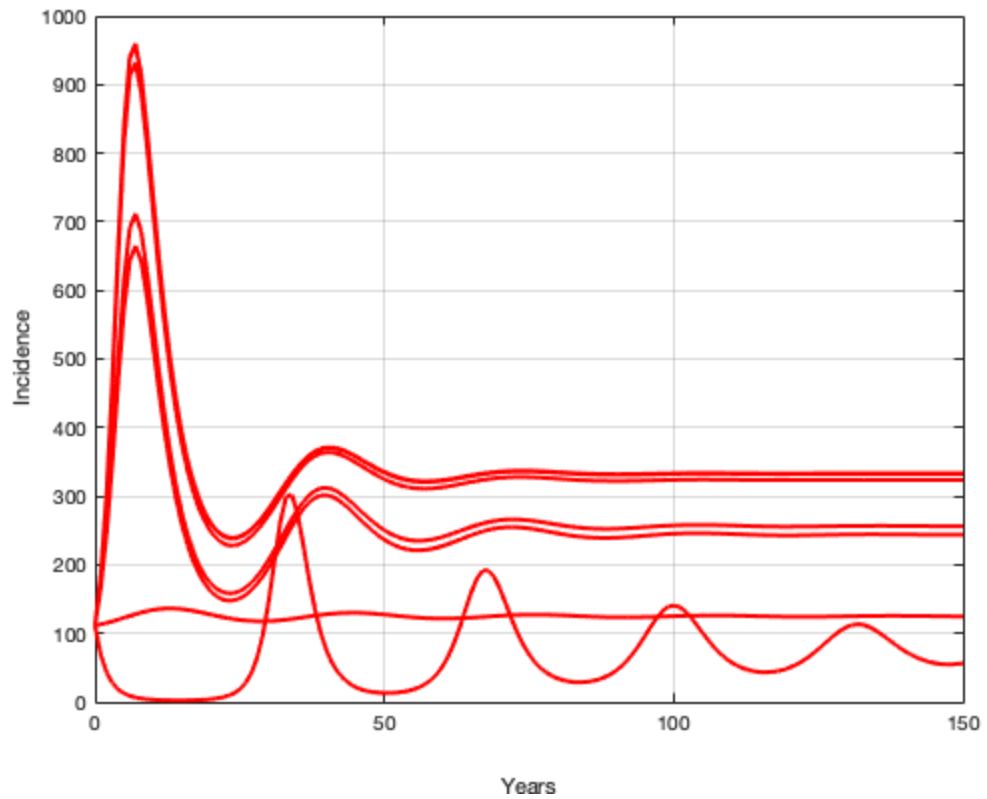
```
ans =
```

```
Axes (suplabel) with properties:
```

```
    XLim: [0 1]
    YLim: [0 1]
    XScale: 'linear'
    YScale: 'linear'
    GridLineStyle: '-'
    Position: [0.0900 0.0700 0.8550 0.8950]
    Units: 'normalized'
```

```
Use GET to show all properties
```





```

DetVec = [0, 0.09, 0.11, 1]; n = length(DetVec); figure for i = 1:n det = DetVec(i); sigma=0.5; deltaI=0.2;
[t, class2]=ode45(@(t, class) simpModDet(t, class, N, beta, nu, b, D, det), T2, class(size(class,1),:));
S=class2(:,1); I=class2(:,2); R=class2(:,3);

```

```

    subplot(n,1,i)
    plot(t,S,'g','LineWidth',2); hold on
    plot(t,I,'r','LineWidth',2); hold on
    plot(t,R,'b','LineWidth',2); hold on
    %axis([0 50 0 500])
    ylabel('Incidence')
    h=legend('Susceptible (S)', 'Infected (I)', 'Recovered (R)', 'Location', 'Location')
end
xlabel('Years')

```

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