Table of Contents

```
%Initial Conditions:
S_0 = 1000; % Susceptible
I_0=1; % Infected
R 0=0; % Recovered
b=100; % birth rate into susceptible
D=0.1; % death rate (independent of disease)
N=1000;
detTime = 50;
endTime = 150;
T1 = 0:detTime;
T2 = detTime+1:endTime;
totalT=0:endTime;
nu=0.2; % Recovery rate
beta=0.001; % Transmission rate
```

0:50 - pre MDT: burn-in

```
det=0;

[t, class]=ode45(@(t, class) simpModDet(t, class, N, beta, nu, b, D,
    det), T1,[S_0 I_0 R_0]);
S=class(:,1);
I=class(:,2);
R=class(:,3);
```

50:150 - post MDT: after burn-in

```
DetVec=[1, 0.5, 0.11, 0.09, 0.009, 0.0009, 0.0001, 0];
Names=string(DetVec);
n = length(DetVec);
figure(1)
for i = 1:n
    det = DetVec(i);
    [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)
    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')
     title(sprintf('$d_{k}= %s
$',Names{i}),'Interpreter','latex', 'FontSize', 12, 'FontName', 'Times
 New Roman');
    R_nought=(beta*b)/(D*(D + nu + det));
     text(100, max(S) * 0.8, sprintf( '$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');
                          Susceptible (S)
                                          Infected (I)

    Recovered (R)

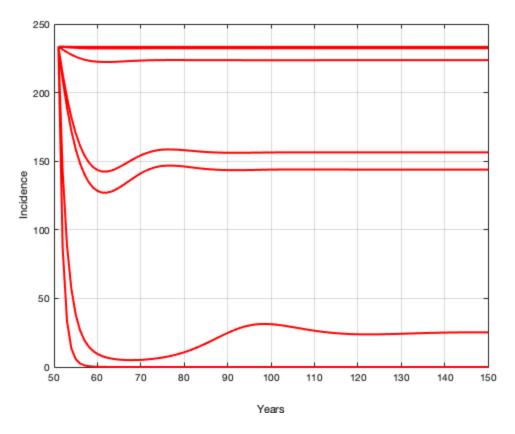
                       d_k = 1
                                                            d_k = 0.5
       1000
                                             1000
    Incidence
                                          Incidence
                         R_0 = 0.7692
                                                                R_0 = 1.2500
        500
                                              500
         0
                                               0
          50
                        100
                                       150
                                                50
                                                              100
                                                                             150
                                                            d_k = 0.09
                      d_k = 0.11
                                           Pucidence
200
      Incidence
        400
                          R_0 = 2.4390
                                                                R_0 = 2.5641
       200
          50
                        100
                                       150
                                                50
                                                              100
                                                                             150
                     d_k = 0.009
                                                           d_k = 0.0009
     100 and 300
                                           90 400
300
                         R_0 = 3.2362
                                                                  -3.3234
                                                                R_{\circ}
        200
                                              200
                                       150
                                                50
          50
                        100
                                                              100
                                                                             150
                     d_k = 0.0001
                                                             d_k = 0
                                            Incidence
        400
                                              400
        300
                                              300
                              3 3322
                                                                    3 3333
        200
                                              200
                        100
                                       150
          50
                                                50
                                                              100
                                                                             150
                                          Years
DetVec=[1, 0.5, 0.11, 0.09, 0.009, 0.0009, 0.0001, 0];
Names=string(DetVec);
n = length(DetVec);
```

```
figure(2)
for i = 1:n
     det = DetVec(i);
     [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';
set(hL,'Position', newPosition,'Units',
 newUnits, 'color','none','Box','off');
                           Susceptible (S)
                                           Infected (I)

    Recovered (R)

                       d_k = 1
                                                             d_k = 0.5
       1000
                                              1000
     Incidence
                          R_0 = 0.7692
                                           Incidence
                                                                 R_0 = 1.2500
        500
                                              500
          0
                                                ا ٥
                                       150
          50
                         100
                                                 50
                                                                100
                                                                              150
                      d_k = 0.11
                                                             d_k = 0.09
     100 Pucidence 200
                                            Pucidence
200
                          R_0 = 2.4390
                                                                 R_0 = 2.5641
                                                 50
                                                                100
          50
                         100
                                       150
                                                                              150
                      d_k = 0.009
                                                            d_k = 0.0009
     Incidence
                                            Incidence
        400
                                              400
                                              300
        300
                          R_0 = 3.2362
                                                                     3.3234
        200
                                               200
                                        150
                                                                100
                                                                              150
                     d_k = 0.0001
                                                              d_k = 0
                                            900 400
300
        400
        300
                               3.3322
                                                                     3 3333
        200
                                               200
                                        150
          50
                                                 50
```

Years

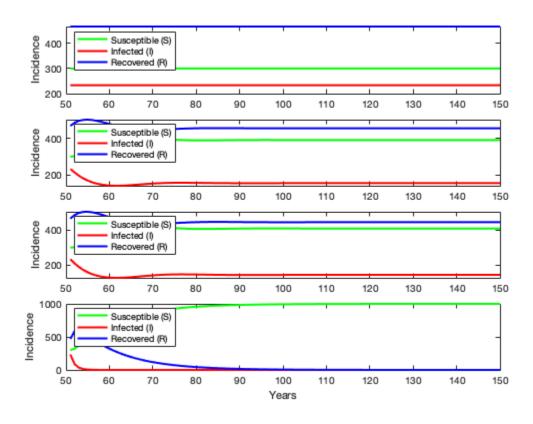


Plotting entire time span 0-150

```
rbind class and class2 figure(4) classes=vertcat(class,class2); S=classes(:,1); I=classes(:,2); R=classes(:,3);
```

```
pl=plot(totalT,S,'g','LineWidth',2); hold on
           p2=plot(totalT,I,'r','LineWidth',2); hold on
           p3=plot(totalT,R,'b','LineWidth',2); hold on
DetVec = [0, 0.09, 0.11, 1];
n = length(DetVec);
figure(3)
for i = 1:n
    det = DetVec(i);
    [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','northwest');
end
xlabel('Years')
```



50:150 - post MDT: after burn-in

```
DetVec=[1, 0.5, 0.11, 0.09, 0.009, 0.0009, 0.0001, 0];
Names=string(DetVec);
n = length(DetVec);
figure(4)
for i = 1:n
    det = DetVec(i);
    [t, class2]=ode45(@(t, class) simpModDet(t, class, N, beta, nu, b,
 D, det), T2, class(size(class,1),:) );
    classes=vertcat(class,class2);
    S=classes(:,1);
    I=classes(:,2);
    R=classes(:,3);
    subplot(0.5*n,2,i)
    pl=plot(totalT,S,'g','LineWidth',2); hold on
    p2=plot(totalT,I,'r','LineWidth',2); hold on
    p3=plot(totalT,R,'b','LineWidth',2); hold on
    x1=50;
    xline(x1,'--');
```

```
%axis([0 150 0 3000])
     ylabel('Incidence')
     title(sprintf('$d_{k}= %s
$',Names{i}),'Interpreter','latex', 'FontSize', 12, 'FontName', 'Times
 New Roman');
     R_nought=(beta*b)/(D*(D + nu + det));
     text(100,max(S)*0.8,sprintf('$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');
clear all
                            Susceptible (S)
                                          Infected (I)

    Recovered (R)

                        d_k = 1
                                                               d_k = 0.5
       1000
                                               1000
                                            Incidence
     Incidence
                                R_0 = 0.7692
        500
                                                500
           0
                    50
                              100
                                        150
                                                            50
                                                                      100
                                                                                150
                       d\nu = 0.11
                                                              d_k = 0.09
       1000
                                               1000
     Incidence
                                R_0 = 2.4390
                                            Incidence
                                                                       R_0 = 2.5641
        500
                                                500
                                        150
                                                                                150
                      d_k = 0.009
                                                             d_k = 0.0009
       1000
                                               1000
     Incidence
                                R_0 = 3.2362
                                            Incidence
                                                                       R_0 = 3.3234
        500
                                                500
          0
                                                 0
           0
                    50
                                        150
                                                  0
                                                            50
                                                                                150
                      d_k = 0.0001
                                                                d_k = 0
       1000
                                               1000
     Incidence
                                R_0 = 3.3322
                                            Incidence
                                                                       R_0 = 3.3333
        500
                                                500
          0
                                                 0
           0
                    50
                              100
                                        150
                                                  0
                                                            50
                                                                      100
                                                                                150
                                            Years
```

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