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## load given mock data

```
close all,clc,clear
load mockdata.mat
mockdata = [newInfections.',cumulativeDeaths.'];
t = length(newInfections);
```

## set up constraints and initial

```
%set up rate and initial condition constraints
% Set A and b to impose a parameter inequality constraint of the form
  A*x < b
A = [];
b = [];

%set up some fixed constraints
% Set Af and bf to impose a parameter constraint of the form Af*x = bf
Af = ones(1,6);
bf = 2;

%set up upper and lower bound constraints
% lb < x < ub
ub = ones(1,6);
lb = zeros(1,6);

% Specify some initial parameters for the optimizer to start from
x0 = [0.01,0.002,0.07,0.001,0.005,0.04];
```

## first 100 days without vaccine

```
t1 = 100;
mockdata100 = mockdata(1:100, :);
sirafun= @(x)vaccine_sirafun_first100(x,t1,mockdata100);
[x100,fval] = fmincon(sirafun,x0,A,b,Af,bf,lb,ub);
disp(x100)
disp(fval)
Y_fit_100 = vaccine_sir_first100(x100,t1);
```

---

*Local minimum possible. Constraints satisfied.*

*fmincon stopped because the size of the current step is less than the value of the step size tolerance and constraints are satisfied to within the value of the constraint tolerance.*

0.0159    0.0487    0.5593    0.4345    0.4213    0.5203  
0.0022

## The rest 265 days with vaccine released

```
t2 = 265;  
mockdatarest = mockdata(101:365, :);  
sirafun= @(x)vaccine_sirafun(x,t2,mockdatarest);  
[x,fval] = fmincon(sirafun,x0,A,b,Af,bf,lb,ub);  
disp(x)  
disp(fval)  
Y_fit = vaccine_sir(x,t2);
```

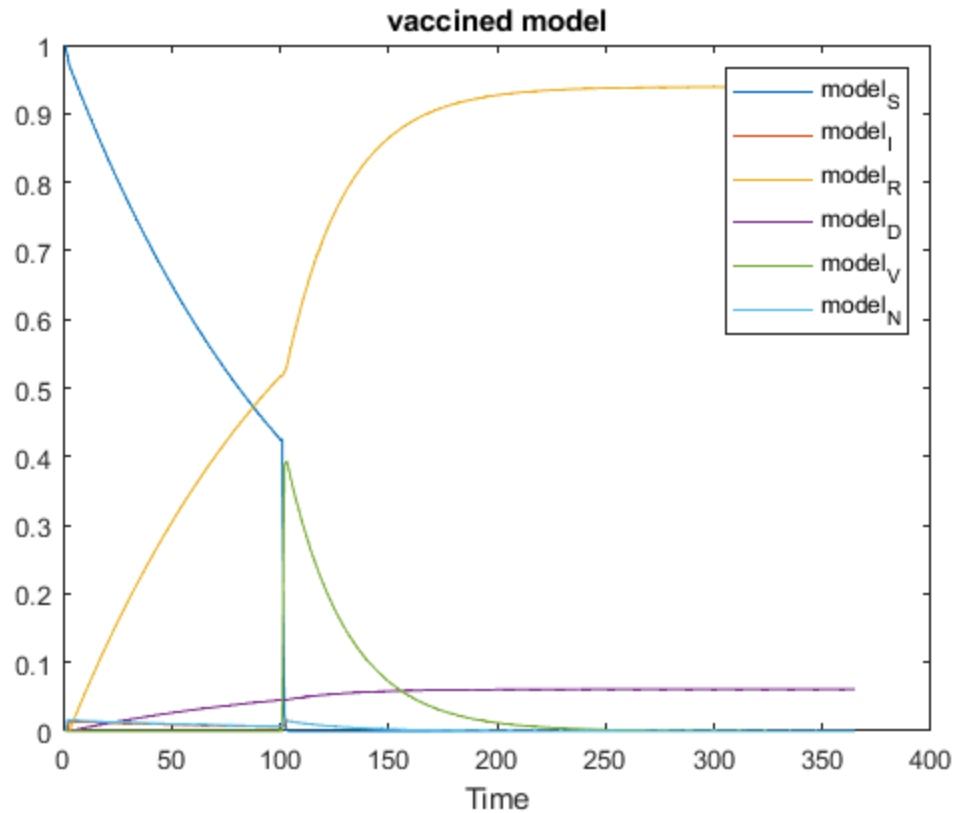
*Local minimum found that satisfies the constraints.*

*Optimization completed because the objective function is non-decreasing in feasible directions, to within the value of the optimality tolerance, and constraints are satisfied to within the value of the constraint tolerance.*

0.0364    0.0367    0.9820    0.9092    0.0355    0.0002  
7.3329e-04

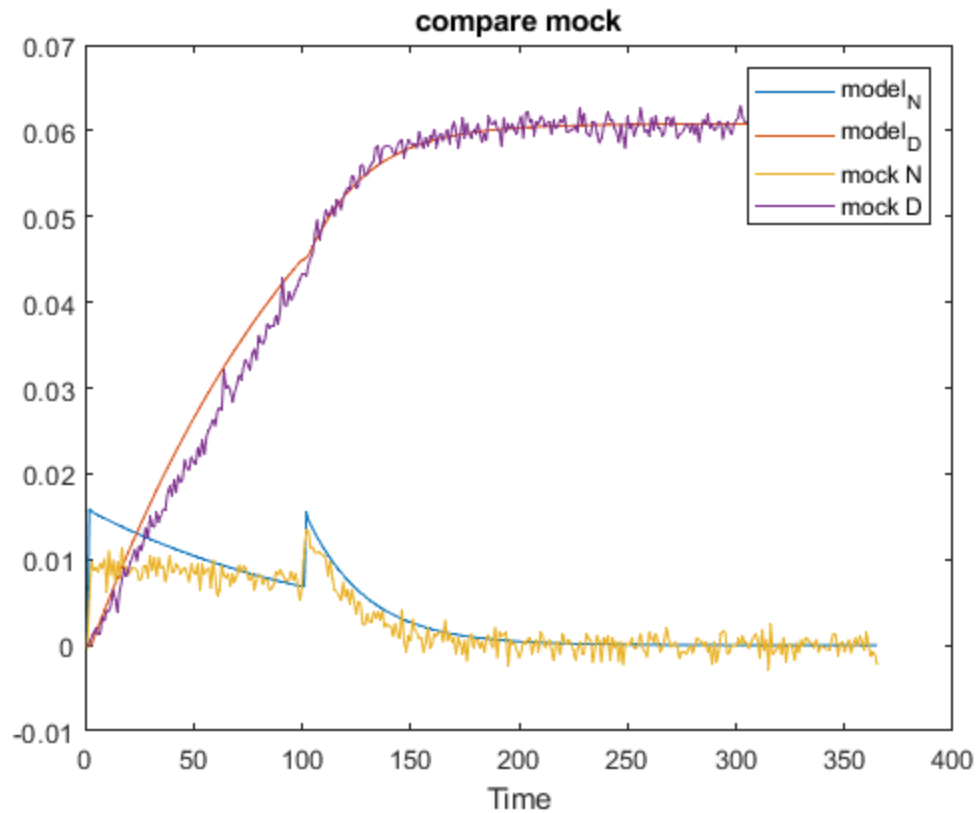
## concatenate the results and plot

```
Y_fit = [Y_fit_100; Y_fit];  
figure();  
plot(Y_fit);  
xlabel('Time')  
legend('model_S', 'model_I', 'model_R', 'model_D', 'model_V', 'model_N')  
title('vaccined model')
```



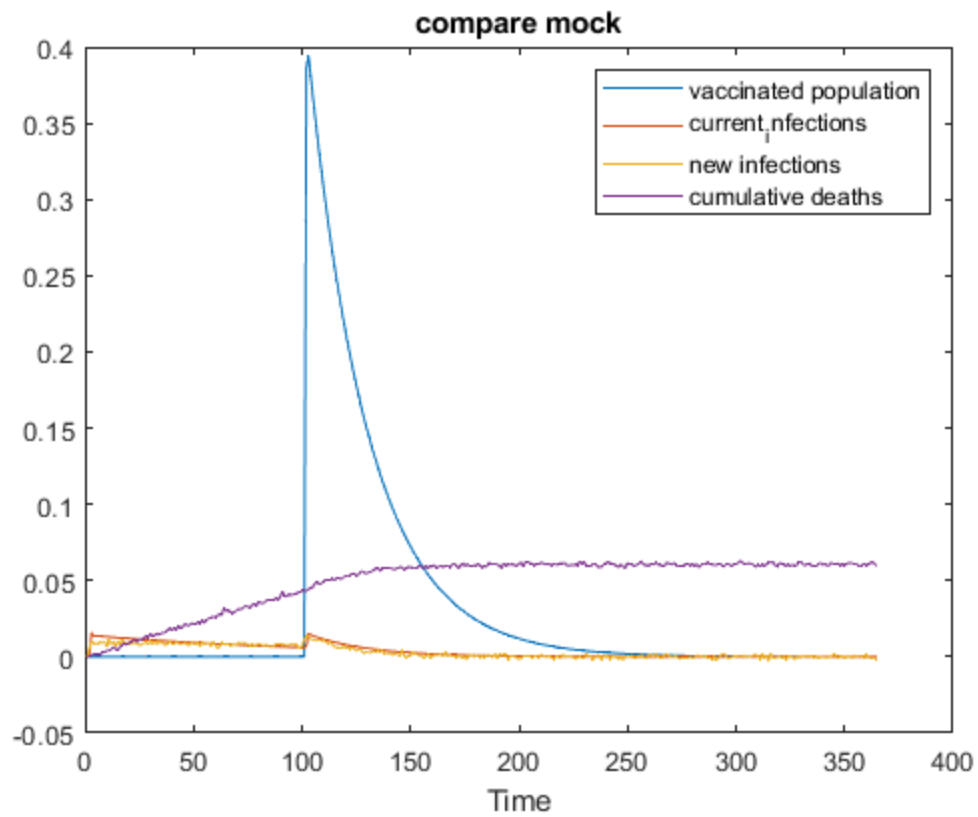
**compare the model with the given mock data**

```
Y_fit= [Y_fit, mockdata];  
Y_compare = [6 4 7 8];  
Y_compare = Y_fit(:, Y_compare);  
figure();  
plot(Y_compare);  
xlabel('Time')  
legend('model_N', 'model_D', 'mock N', 'mock D')  
title('compare mock')
```



## action item implement

```
Y_action = [5 2 7 8];  
Y_action = Y_fit(:, Y_action);  
figure();  
plot(Y_action);  
xlabel('Time')  
legend('vaccinated population', 'current_infections', 'new  
infections', 'cumulative deaths')  
title('compare mock')
```



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