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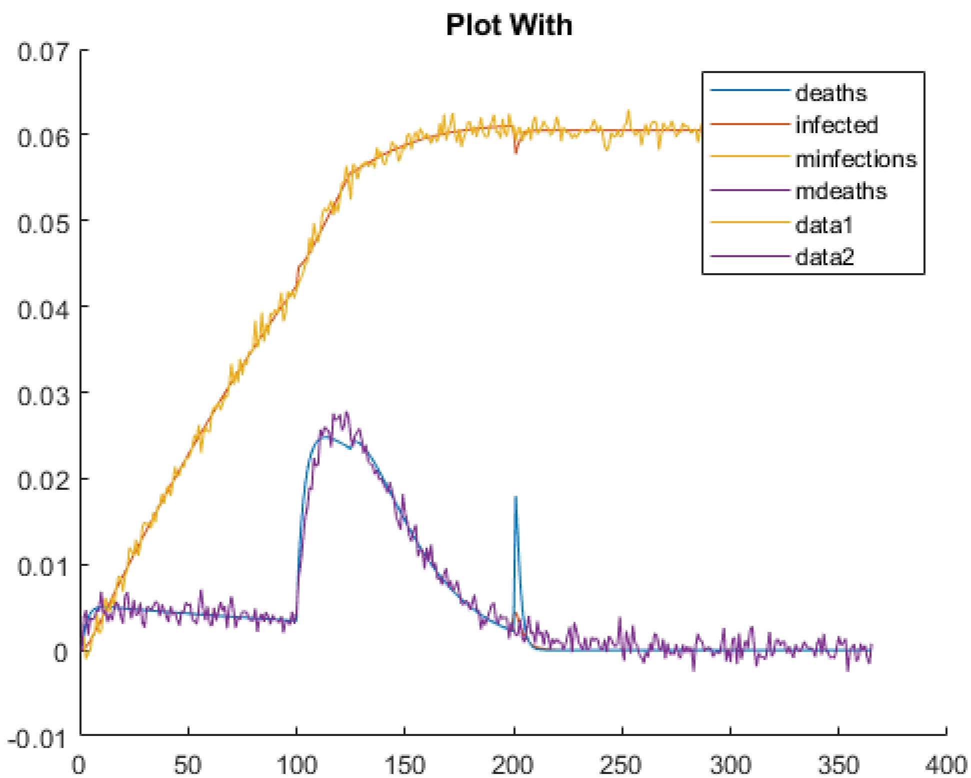
Load data and plot

```
data = load("mockdata_v2.mat");
infected = transpose(deal(data.InfectedProportion));    % Turn these from rows
 to columns
deaths = transpose(deal(data.cumulativeDeaths));
data = [infected deaths];

figure(1);
hold on;
plot(deaths);                                      % Plot actual data
plot(infected);
```



Setup

```
A = [0 0 0 .99 .99 .99 .99];
b = 1;
Af = [0 0 0 1 1 1 1];
bf = 1;
ub = [1 1 1 1 1 1 1]';
lb = [0 0 0 0 0 0 0]';
x0 = [0 0 0 1 0 0 0];
```

First Segment: Days 1-100

```
t = 100;
seg1 = data(1:100,:);

fun1= @(x1)siroutput_part3(x1,t,seg1);
x1 = fmincon(fun1,x0,A,b,Af,bf,lb,ub);
Y_fit_1 = siroutput_full(x1,t);

New1(1) = Y_fit_1(100, 1);
New1(2) = Y_fit_1(100, 2);
New1(3) = Y_fit_1(100, 3);
New1(4) = Y_fit_1(100, 4);
```

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.*

Second Segment: Days 101-125

```
t = 25;

seg2 = data(101:125, :);
fun2= @(x2)siroutput_part3(x2,t,seg2);
params2 = [x1(1) x1(2) x1(3) New1(1) New1(2) New1(3) New1(4)];
x2 = fmincon(fun2, params2, A, b, Af, bf, lb, ub);
Y_fit_2 = siroutput_full(x2, t);

New2(1) = Y_fit_2(25, 1);
New2(2) = Y_fit_2(25, 2);
New2(3) = Y_fit_2(25, 3);
New2(4) = Y_fit_2(25, 4);
```

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.
```

Third Segment: Days 126-199

```
t = 75;                                         % Next 50 days: descent from
 peak

seg3 = data(126:200, :);
fun3= @(x3)siroutput_part3(x3,t,seg3);
params3 = [x2(1) x2(2) x2(3) New2(1) New2(2) New2(3) New2(4)];
x3 = fmincon(fun3, params3, A, b, Af, bf, lb, ub);
Y_fit_3 = siroutput_full(x3, t);

New3(1) = Y_fit_3(50, 1);
New3(2) = Y_fit_3(50, 2);
New3(3) = Y_fit_3(50, 3);
New3(4) = Y_fit_3(50, 4);
```

```
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.
```

Fourth Segment: Days 201-365

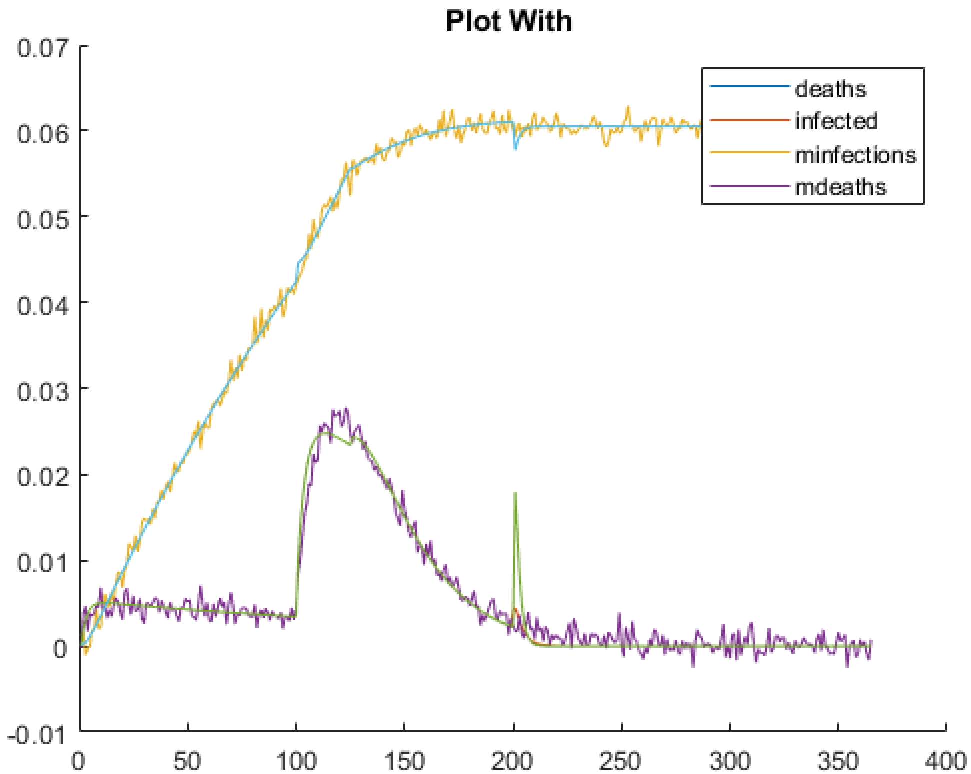
```
t = 365-200;                                        % Next 50 days: descent
 from peak

seg4 = data(201:365, :);
fun4= @(x4)siroutput_part3(x4,t,seg4);
params4 = [x3(1) x3(2) x3(3) New3(1) New3(2) New3(3) New3(4)];
x4 = fmincon(fun4, params4, A, b, Af, bf, lb, ub);
Y_fit_4 = siroutput_full(x4, t);
```

```
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.
```

Plot

```
Y_fit = cat(1,Y_fit_1,Y_fit_2,Y_fit_3,Y_fit_4);         % Put 3 fits together

plot(Y_fit(:,2));
plot(Y_fit(:,4));
```

```
legend('deaths','infected','minfections','mdeaths');
title('Plot With ')
hold off;
```



Figuring vaccinated and breakthrough

```
StandardInfRate = sum(Y_fit(1:100,2))/100;

PreVax = zeros(100,1);

InitialDeathRate = x1(2);
SecondDeathRate = x2(2);
ThirdDeathRate = x3(2);


% CDC says that 10% of vaccinated experience breakthrough cases, so assume
 roughly
% 10% of initial vaccinated get sick. The death rate doesn't drastically
% change, and vaccinated have a very reduced death rate, so we can assume
% the entire spike must be breakthrough cases.


% The difference between segment 2/3 percentages and the standard infection
% percentage is breakthroughs for these segments, for unvaxxed becomes
% negligible for these portions. The vaccination percentage is so high by end
```

```
% that pretty much all infections in segment 4 are breakthrough.

PostVaxBT1 = Y_fit_2(:,2) - StandardInfRate*ones;
PostVaxBT2 = Y_fit_3(:,2) - StandardInfRate*ones;
PostVaxBT3 = Y_fit_4(:,2);

vaxbreak = abs(cat(1,PreVax,PostVaxBT1,PostVaxBT2,PostVaxBT3));

% Vaxxed population related to breakthroughs according CDC data, where 10%
% of vaxxed pop experiences breakthroughs.

vaxpop = zeros(365,1);
vaxpop(101) = 9*vaxbreak(101); % 90%/10% = 9
for i = 102:200
    vaxpop(i) = vaxpop(i-1) + 0.00945;  % Linear relationship up to 100% where
 deaths plateau
end
for i = 201:365
    vaxpop(i) = 1;
end


% Cases spike, but death rate doesn't drastically increase. Fairly
% consistent over this period, assume vaccination rate consistent from day
% 1 to day 25.
```

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