```
test_data =
 COVID_MO(isbetween(COVID_MO.date,datetime('2021-01-01'),datetime('2021-10-01')),
```

Select the Data to be fit

```
coviddata = double(table2array(test_data(:,[3:4])))./(150198 + 2805473
 + 475220);
period = test_data;
t = height(coviddata);
dates =  table2array(period(:,1));

sirafun= @(x)sirloutput(x,t,coviddata);

A = [];
b = [];
Af = [1 1 1 1 1 1 1 0 0 0 0 0; 0 0 0 0 0 0 0 1 1 1 1 1];
bf = [1; 1];
ub = [0.30, .995, 0.1, 1, 0.5, 0.5, 1, 1, 0.7, 1, 0.2, 0.1]';
lb = [0, 0, 0, 0, 0, 0, 0,.90, 0, 0, 0, 0]';

% Specify some initial parameters for the optimizer to start from
% form of x = [new_infections, continued infections, fatalities,
 recovery with immunity, initial S, intial I, initial R, initial D]

x0 = [0.05,0.85,0.01,0.1,0,0,0.04,1,0,0,0,0];

% This is the key line that tries to opimize your model parameters in
 order to
% fit the data
% note tath you
x = fmincon(sirafun,x0,A,b,Af,bf,lb,ub);

%plot(Y);
%legend('S',L','I','R','D');
%xlabel('Time')

Y_fit = sirloutput_full(x,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.

sys_sir_base =

A =

	x1	x2	x3	x4	x5
x1	0.9979	0.998	2.278e-06	0	0
x2	0.001771	0.002034	0	0	0

```
  x3  0.0003669           0     0.9938          0          0
  x4          0           0   0.002025          1          0
  x5          0           0  6.332e-06          0          1

B =
       u1
 x1     0
 x2     0
 x3     0
 x4     0
 x5     0

C =
       x1  x2  x3  x4  x5
 y1     1   0   0   0   0
 y2     0   1   0   0   0
 y3     0   0   1   0   0
 y4     0   0   0   1   0
 y5     0   0   0   0   1

D =
       u1
 y1     0
 y2     0
 y3     0
 y4     0
 y5     0

Sample time: 1 seconds
Discrete-time state-space model.
```

```
k_new_infections = x(1); % percent of suseptable people who get
 infections
k_infections = x(2);
k_fatality = x(3);
k_recover = x(4); %recovered with imunity
k_recover_s = x(5);
k_new_lockdown = x(6);
k_lockdown = x(7);
current_policy = [(1-k_new_infections-k_new_lockdown),   1-k_lockdown,
 k_recover_s,  0,   0;
     k_new_lockdown,                         k_lockdown,          0   ,
  0,   0;
     k_new_infections,                                  0, k_infections,
  0,   0;
     0,                                                 0, k_recover,
  1,   0;
     0,                                                 0, k_fatality,
  0,   1;];



 Y_with_Policy = zeros(5, t);
```

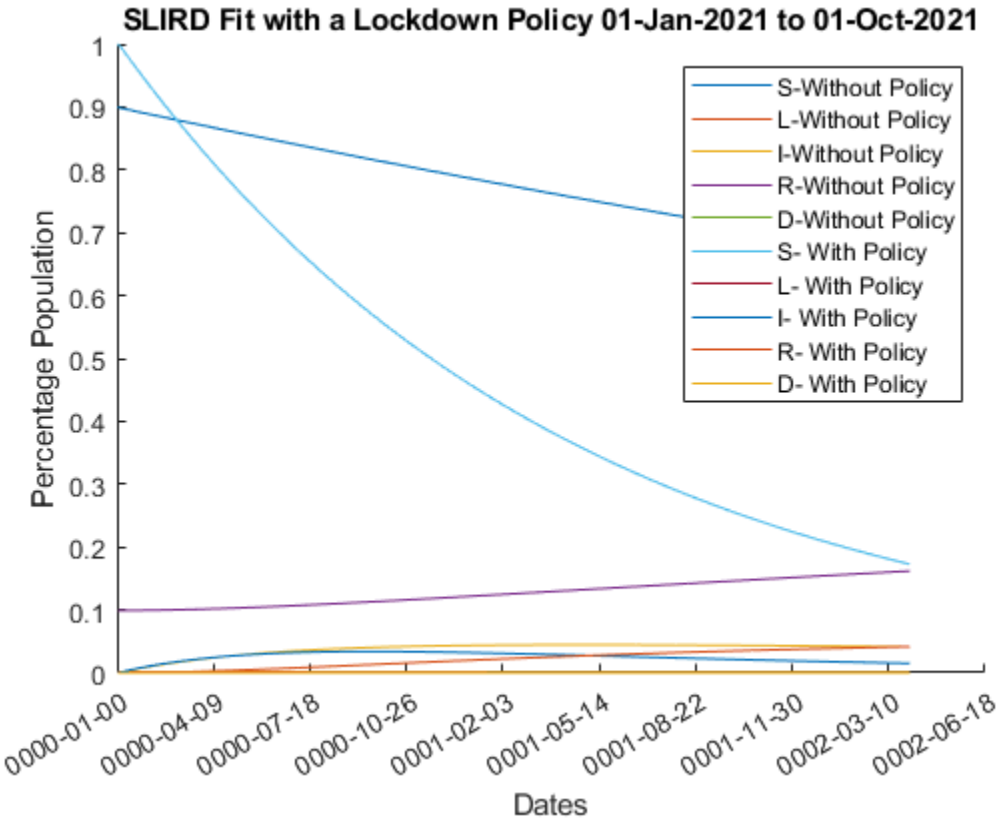
```
 Y_with_Policy(:,1) = x0(8:12);

 for i = 2:t

     Y_with_Policy(:,i) = current_policy*( Y_with_Policy(:,i-1));
     current_policy = sirpolicy(current_policy, Y_with_Policy(:,i));

 end

figure();
hold on;
plot(Y_fit);
plot(Y_with_Policy');
datetick('x', 'yyyy-mm-dd','keepticks');
hold off;
legend('S-Without Policy','L-Without Policy','I-Without Policy','R-
Without Policy','D-Without Policy','S- With Policy','L- With
 Policy','I- With Policy','R- With Policy','D- With Policy')
xlabel('Dates')
ylabel('Percentage Population')
title("SLIRD Fit with a Lockdown Policy " + datestr(dates(1)) + " to "
 + datestr(dates(length(dates))))
```



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