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```
% CSCE 666
% COVID-19 Project
% SAA parameter estimation
%
% The SIRD model estimates deaths from an epidemic using an ODE.
% The solution to the ODE is parameterized by:
% r0 : transmission rate
% d  : mortality rate
%
% This script finds the paramter values which best fit the SIRD model
 to
% real data for 210 counties in the USA using a Simulated Annealing
 Algorithm.
%
% The resulting parameters for each county are saved in the file []
% for further analysis and feature correlation.

clear; clc;
```

Load files, prepare data

```
population   = csvread('us-county-population_2.csv');
num_counties = length(population);
FIPS = population(1,:);

cases_data = readtable('us-county-cases_2.csv');
mortality_rates = csvread('Mortality_Rate_Summary.csv');

% Specify the SAA options for in-training monitoring
options = optimoptions('simulannealbnd','PlotFcns',...
          {@saplotbestx,@saplotbestf,@saplotx,@saplotf});
options.MaxStallIterations = 500;
```

Prepare and Run Simulated Annealing Algorithm

Create a variable to store parameter values for each county

```
params = zeros(4, num_counties);
params(1,:) = FIPS;
r0_list = linspace(1.0, 3.5, 50);
```

```
trials = zeros(length(r0_list), num_counties);
for county = 1:num_counties
    % Population of county
    pop = population(2, county);
    init_cases = cases_data.(county);
    Iinit = init_cases(2);

    fprintf('\nCounty: %g\nFIPS:   %g\n', [county, FIPS(county)])
    % Initial guess for [r0 d] for a given county with population
 'pop'
    x0 = [2.5 0.05 county pop Iinit];
    % bounds defined as: [r0 d]
    % note that 'county' and 'pop' are not allowed to change
    lb = [1.0 0.01 county pop Iinit];
    ub = [4.0 0.10 county pop Iinit];
    [x, mserror] = simulannealbnd(@mse_sir, x0, lb, ub, options);
    params(2, county) = x(1);
    params(3, county) = x(2);
    params(4, county) = mserror;

    fprintf('r0  = %f \nd   = %f\nPop = %e\nMSE = %f\n', [x(1), x(2),
 pop, mserror])
end
```

Export Results

```
csvwrite('params.csv', params)
```

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