Set up:

param\_struct = ...

    {'beta\_h', 0.24;

     'beta\_v', 0.24;

     'gamma\_h', 1/6;

     'mu\_h', 1/(70\*365);

     'nu\_h', 1/3;

     'psi\_v', 0.3;

     'mu\_v', 1/17;

     'nu\_v', 1/11;

     'sigma\_h1', 10; %low risk contacts

     'sigma\_h2', 30; %high risk contacts

     'sigma\_v', 0.5;

     'H0', 100;

     'theta1', 1-param(1); %proportion of population in group 1 - low risk

     'theta2', param(1);% proportion of population in group 2 - high risk

     'theta0', .8; % no risk group

     'init\_cumulative\_infected', param(4);

     'K\_v' , param(5);

     'pi1', param(2); %proportion that continues to be bitten in infected group 1

     'pi2', param(3); %proportion that continues to be bitten in infected group 2

    }';

params = struct(param\_struct{:});

init =  ...

    [param.H0 \*param.theta1 - param.init\_cumulative\_infected\*param.theta1,

     param.H0\* param.theta2 - param.init\_cumulative\_infected\*param.theta2,

     param.init\_cumulative\_infected \* param.theta1,

     param.init\_cumulative\_infected \* param.theta2,

     0,

     0,

     param.init\_cumulative\_infected \* param.theta1,

     param.init\_cumulative\_infected \* param.theta2,

     param.K\_v\*0.75,

     0,

     0];

str.psol=[0.7,0.6,.8,4,1000]'; % initial guess at the solution for the parameters

str.ub = [1,1, 1,10,1500]';

str.lb = [0.5,0, 0.1,1,900]';

str.noise\_sd=0.05;

The pfit solution values are

pfit =

8.7711e-01

9.9990e-01

4.8173e-01

3.5887e+00

1.4997e+03

BEGIN RESIDUAL ANALYSIS TESTS

Gaussian process models about the data fit should satisfy the conditions

residual mean = -0.010582 approx 0.17755 = residual median

residual STD = 4.6016 approx 3.6526 = residual MAD

Randomness test that the ratio of positive to negative res1d = 0.52475 is close to 0.5

No residual trend indicated if the trend threshold = 95 > 0 = autocorrelation

BEGIN BOOTSTRAP ANALYSIS mean pfit 95% CI delta

8.6688e-01 2.2676e-02

6.0061e-01 2.1257e-01

6.0022e-01 6.7558e-02

3.6828e+00 1.2371e-01

1.2035e+03 1.3102e+02

Correlation coefficients

Columns 1 through 4

1.0000e+00 6.2430e-02 -8.0370e-01 5.1106e-01

6.2430e-02 1.0000e+00 1.3902e-01 1.5224e-01

-8.0370e-01 1.3902e-01 1.0000e+00 -4.0755e-01

5.1106e-01 1.5224e-01 -4.0755e-01 1.0000e+00

4.0075e-01 -3.7509e-01 -8.5807e-01 1.3589e-01

Column 5

4.0075e-01

-3.7509e-01

-8.5807e-01

1.3589e-01

1.0000e+00

BEGIN LOCAL IDENTIFIABILITY HESSIAN ANALYSIS

Hessian

Columns 1 through 4

6.4823e+05 5.9129e+03 6.2858e+05 1.6876e+04

5.9129e+03 5.4941e+01 5.5758e+03 1.4039e+02

6.2858e+05 5.5758e+03 6.3039e+05 1.8539e+04

1.6876e+04 1.4039e+02 1.8539e+04 7.2140e+02

1.2042e+02 1.0707e+00 1.2034e+02 3.5068e+00

Column 5

1.2042e+02

1.0707e+00

1.2034e+02

3.5068e+00

2.2981e-02

Fisher information matrix

Columns 1 through 4

6.4805e+05 6.0084e+03 6.2902e+05 1.6892e+04

6.0084e+03 5.7053e+01 5.6830e+03 1.4295e+02

6.2902e+05 5.6830e+03 6.3070e+05 1.8528e+04

1.6892e+04 1.4295e+02 1.8528e+04 7.2108e+02

1.2084e+02 1.0950e+00 1.2070e+02 3.5068e+00

Column 5

1.2084e+02

1.0950e+00

1.2070e+02

3.5068e+00

2.3109e-02

The norm of the gradient = 1.7868 should be small at the minimium

The condition number of the Hessian = 502779960149.4924

should be < 29308.5902 for all variables to be structually identifiable

None of the variables are structually identifiable

The parameters

'K\_v'

are practically identifiable

The vectors 1 2 3 4 are structually identifiable

The vectors 1 2 3 4 are practically identifiable

Singular values

Columns 1 through 4

1.2685e+06 1.0847e+04 5.4708e+01 3.3777e-01

Column 5

2.5230e-06

The vectors spanning the stuctural identifiable space are

-7.1194e-01 -6.9805e-01 7.3835e-02 -2.0317e-02

-6.4065e-03 -1.6780e-02 5.4299e-02 9.9836e-01

-7.0193e-01 7.0460e-01 -1.0324e-01 1.2953e-02

-1.9743e-02 1.2641e-01 9.9042e-01 -5.1870e-02

-1.3423e-04 1.0644e-04 -1.6194e-05 2.2079e-03

The vectors spanning the stuctural non-identifiable space are

Nonidentiviable vectors

2.4789e-05

-2.2025e-03

-1.9950e-04

1.1446e-04

1.0000e+00