

```

> #John Hermitt hw19
  read "/John/Rutgers/Senior Fall/Dynamic Models/M19.txt";
> #I
#i
N := 1000;
nu := 1;
A1 := SIRS(s, i,  $\frac{0.3 \cdot nu}{N}$ , 3, nu, N);
A2 := SIRS(s, i,  $\frac{0.9 \cdot nu}{N}$ , 3, nu, N);
A3 := SIRS(s, i,  $\frac{3.9 \cdot nu}{N}$ , 3, nu, N);
X1 := Dis2(A1, s, i, [1000, 200], 0.01, 1) :
X2 := Dis2(A2, s, i, [1000, 200], 0.01, 1) :
X3 := Dis2(A3, s, i, [1000, 200], 0.01, 1) :
op(nops(X1) - 3 ..nops(X1), X1);
op(nops(X2) - 3 ..nops(X2), X2);
op(nops(X3) - 3 ..nops(X3), X3);

#ii
nu2 := 2;
B1 := SIRS(s, i,  $\frac{0.3 \cdot nu2}{N}$ , 3, nu2, N);
B2 := SIRS(s, i,  $\frac{0.9 \cdot nu2}{N}$ , 3, nu2, N);
B3 := SIRS(s, i,  $\frac{3.9 \cdot nu2}{N}$ , 3, nu2, N);
Y1 := Dis2(B1, s, i, [1000, 200], 0.01, 1) :
Y2 := Dis2(B2, s, i, [1000, 200], 0.01, 1) :
Y3 := Dis2(B3, s, i, [1000, 200], 0.01, 1) :
op(nops(Y1) - 3 ..nops(Y1), Y1);
op(nops(Y2) - 3 ..nops(Y2), Y2);
op(nops(Y3) - 3 ..nops(Y3), Y3);

#iii
nu3 := 3;
C1 := SIRS(s, i,  $\frac{0.3 \cdot nu3}{N}$ , 7, nu3, N);
C2 := SIRS(s, i,  $\frac{0.9 \cdot nu3}{N}$ , 7, nu3, N);
C3 := SIRS(s, i,  $\frac{3.9 \cdot nu3}{N}$ , 7, nu3, N);
Z1 := Dis2(C1, s, i, [1000, 200], 0.01, 1) :
Z2 := Dis2(C2, s, i, [1000, 200], 0.01, 1) :
Z3 := Dis2(C3, s, i, [1000, 200], 0.01, 1) :
op(nops(Z1) - 3 ..nops(Z1), Z1);
op(nops(Z2) - 3 ..nops(Z2), Z2);

```

```
op(nops(Z3) - 3..nops(Z3), Z3);
```

```
N := 1000
```

```
v := 1
```

```
A1 := [-0.0003000000000 si + 3000 - 3 s - 3 i, 0.0003000000000 si - i]
```

```
A2 := [-0.0009000000000 si + 3000 - 3 s - 3 i, 0.0009000000000 si - i]
```

```
A3 := [-0.0039000000000 si + 3000 - 3 s - 3 i, 0.0039000000000 si - i]
```

```
[0.98, [873.8788959, 97.87805546]], [0.99, [874.4695866, 97.15587561]], [1.00, [875.0659431,  
96.43919643]], [1.01, [875.6676169, 95.72797644]]
```

```
[0.98, [798.1621275, 158.1743141]], [0.99, [798.3357956, 157.7288097]], [1.00, [798.5205724,  
157.2848066]], [1.01, [798.7160546, 156.8423149]]
```

```
[0.98, [277.0085804, 570.6966052]], [0.99, [275.4119984, 571.1550655]], [1.00, [273.8801710,  
571.5783302]], [1.01, [272.4112011, 571.9677618]]
```

```
v2 := 2
```

```
B1 := [-0.0006000000000 si + 3000 - 3 s - 3 i, 0.0006000000000 si - 2 i]
```

```
B2 := [-0.0018000000000 si + 3000 - 3 s - 3 i, 0.0018000000000 si - 2 i]
```

```
B3 := [-0.0078000000000 si + 3000 - 3 s - 3 i, 0.0078000000000 si - 2 i]
```

```
[0.98, [913.3710930, 48.09333999]], [0.99, [914.2635976, 47.39503559]], [1.00, [915.1538493,  
46.70712421]], [1.01, [916.0415549, 46.02944696]]
```

```
[0.98, [797.9516805, 121.5475876]], [0.99, [798.6208987, 120.8624396]], [1.00, [799.2989796,  
120.1826097]], [1.01, [799.9854188, 119.5080706]]
```

```
[0.98, [222.9883628, 470.3243021]], [0.99, [224.0085888, 469.0982101]], [1.00, [225.0189866,  
467.9126441]], [1.01, [226.0184778, 466.7669511]]
```

```
v3 := 3
```

```
C1 := [-0.0009000000000 si + 7000 - 7 s - 7 i, 0.0009000000000 si - 3 i]
```

```
C2 := [-0.0027000000000 si + 7000 - 7 s - 7 i, 0.0027000000000 si - 3 i]
```

```
C3 := [-0.0117000000000 si + 7000 - 7 s - 7 i, 0.0117000000000 si - 3 i]
```

```
[0.98, [962.0577954, 23.61110356]], [0.99, [962.8565353, 23.10720767]], [1.00, [963.6388330,  
22.61423177]], [1.01, [964.4049909, 22.13193239]]
```

```
[0.98, [858.5496617, 95.86786924]], [0.99, [859.5181368, 95.21413098]], [1.00, [860.4772446,  
94.56734041]], [1.01, [861.4270515, 93.92739240]]
```

```
[0.98, [256.1433805, 520.1113867]], [0.99, [256.2184454, 520.0951465]], [1.00, [256.2853114, (1)  
520.0834746]], [1.01, [256.3445950, 520.0758718]]
```

```
> #2
```

```
F := RandNice([x, y], 8);
```

```
ept := EquPts(F, [x, y]);
```

```
pt := StEquPts(F, [x, y]);
```

```
A := Dis2(F, x, y, pt + [0.1, 0.1], 0.01, 10) :
```

```
op(nops(A) - 3..nops(A), A);
```

```
A := Dis2(F, x, y, ept[1] + [0.1, 0.1], 0.1, 10) :
```

```
op(nops(A) - 3..nops(A), A);
```

```
F := RandNice([x, y], 8);
```

```
ept2 := EquPts(F, [x, y]);
```

```
pt2 := StEquPts(F, [x, y]);
```

```
B := Dis2(F, x, y, pt2 + [0.1, 0.1], 0.01, 10) :
```

```
op(nops(B) - 3..nops(B), B);
```

```
B := Dis2(F, x, y, ept2[1] + [0.1, 0.1], 0.1, 10) :
```

```
op(nops(B) - 3..nops(B), B);
```

```
F := RandNice([x, y], 8);
```

```
ept3 := EquPts(F, [x, y]);
```

```
pt3 := StEquPts(F, [x, y]);
```

```
C := Dis2(F, x, y, pt3 + [0.1, 0.1], 0.01, 10) :
```

```
op(nops(C) - 3..nops(C), C);
```

```
C := Dis2(F, x, y, ept3[1] + [0.1, 0.1], 0.1, 10) :
```

```
op(nops(C) - 3..nops(C), C);
```

$$F := [(4 - 8x - 3y)(3 - x - 2y), (5 - 4x - 5y)(6 - 2x - 3y)]$$

$$ept := \left\{ [3, 0], \left[-\frac{5}{3}, \frac{7}{3} \right], \left[-\frac{1}{3}, \frac{20}{9} \right], \left[\frac{5}{28}, \frac{6}{7} \right] \right\}$$

$$pt := \left\{ \left[\frac{5}{28}, \frac{6}{7} \right] \right\}$$

Error, improper op or subscript selector

[9.8, [Float(∞), Float(∞)]], [9.9, [Float(∞), Float(∞)]], [10.0, [Float(∞), Float(∞)]],

[10.1, [Float(∞), Float(∞)]]

$$F := [(4 - x - 5y)(3 - 8x - y), (6 - 5x - 6y)(7 - 4x - 7y)]$$

$$ept2 := \left\{ \left[\frac{6}{19}, \frac{14}{19} \right], \left[\frac{7}{13}, \frac{9}{13} \right], \left[\frac{7}{26}, \frac{11}{13} \right], \left[\frac{12}{43}, \frac{33}{43} \right] \right\}$$

$$pt2 := \left\{ \left[\frac{6}{19}, \frac{14}{19} \right] \right\}$$

(2)

> #3

```
print(SIRS);
```

```
F := SIRS(s, i, beta, gamma, nu, J);
```

```
EquPts(F, [s, i]);
```

```
proc(s, i, β, γ, ν, N) [ -s*i*β + γ*(N - s - i), s*i*β - ν*i ] end proc
```

$$F := [-s i \beta + \gamma (J - s - i), s i \beta - \nu i]$$

$$\left\{ [J, 0], \left[\frac{\nu}{\beta}, \frac{\gamma(J\beta - \nu)}{\beta(\gamma + \nu)} \right] \right\}$$

(3)

> #4

```
Chemostat := proc(n, c, a1, a2)
```

```
  [ a1 * ( c / (1 + c) ) * n - n, - c / (1 + c) * n - c + a2 ] :
```

```
end;
```

```
C := Chemostat(n, c, a1, a2);
```

$EquPts(C, [n, c]);$

$$C := \left[\frac{a_1 c n}{c+1} - n, -\frac{c n}{c+1} - c + a_2 \right]$$
$$\left\{ [0, a_2], \left[\frac{a_1 (a_2 a_1 - a_2 - 1)}{a_1 - 1}, \frac{1}{a_1 - 1} \right] \right\}$$

(4)

