

# MATLAB Codes Set

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Note:

- This is a set of our project codes
  - Our codes contain 5 models and 1 simulation blocks
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## 1. model\_with\_phi.m

```
1 function dx = model_with_phi(t, x)
2 % This is the model with only phi(I)
3 % List the parameters and equations here
4 d = 1;
5 r = 1;
6 beta = 1;
7 N = 1000;
8 dx(1) = d * N - beta * x(1) * x(2) / (1 + x(2)) - d * x(1);% x(1) is S
9 dx(2) = beta * x(1) * x(2) / (1 + x(2)) - d * x(2) - r * x(2);% x(2) is I
10 dx(3) = r * x(2) - d * x(3);% x(3) is R
11 dx = dx(:);
12 end
```

## 2. model\_with\_phi2.m

```
1 function dx = model_with_phi2(t, x)
2 % This is the model with only phi(I)
3 % List the parameters and equations here
4 d = 1;
5 r = 1;
6 beta = 1;
7 N = 1000;
8 dx(1) = d * N - beta * x(1) * x(2) / (1 + 0.001 * x(2) + 0.001 * x(2)^2) - d * x(1);%
  x(1) is S
9 dx(2) = beta * x(1) * x(2) / (1 + 0.001 * x(2) + 0.001 * x(2)^2) - d * x(2) - r *
  x(2);% x(2) is I
10 dx(3) = r * x(2) - d * x(3);% x(3) is R
11 dx = dx(:);
12 end
```

## 3. model\_with\_phi\_exp.m

```

1 function dx = model_with_phi_exp(t, x)
2 % This is the model with only phi(I) = 100 + e^{-I}
3 % List the parameters and equations here
4 d = 1;
5 r = 1;
6 beta = 1;
7 N = 1000;
8 dx(1) = d * N - beta * x(1) * x(2) / (100 + exp(1)^(-x(2))) - d * x(1); % x(1) is S%
    (100 + exp(1)^(-x(2)))
9 dx(2) = beta * x(1) * x(2) / (100 + exp(1)^(-x(2))) - d * x(2) - r * x(2); % x(2) is I
10 dx(3) = r * x(2) - d * x(3); % x(3) is R
11 dx = dx(:);
12 end

```

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#### 4. model\_with\_r.m

```

1 function dx = model_with_r(t, x)
2 % This is the model with only r(I)
3 % List the parameters and equations here
4 d = 0.01;
5 % r = 1;
6 beta = 0.01;
7 N = 1000;
8 dx(1) = d * N - beta * x(1) * x(2) - d * x(1); % x(1) is S
9 dx(2) = beta * x(1) * x(2) - d * x(2) - (0.5 + (1 - 0.5) * 1 / (1 + x(2))) * x(2); %
    x(2) is I
10 dx(3) = (0.5 + (1 - 0.5) * 1 / (1 + x(2))) * x(2) - d * x(3); % x(3) is R
11 dx = dx(:);
12 end

```

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#### 5. model\_with\_both.m

```

1 function dx = model_with_both(t, x)
2 % This is the model with r(I) & \phi(I)
3 % List the parameters and equations here
4 d = 0.01;
5 % r = 1;
6 beta = 0.01;
7 N = 1000;
8 dx(1) = d * N - beta * x(1) * x(2) / (1 + 0.001 * x(2) + 0.001 * x(2)^2) - d * x(1); %
    x(1) is S
9 dx(2) = beta * x(1) * x(2) / (1 + 0.001 * x(2) + 0.001 * x(2)^2) - d * x(2) - (0.5 +
    (1 - 0.5) * 1 / (1 + x(2))) * x(2); % x(2) is I
10 dx(3) = (0.5 + (1 - 0.5) * 1 / (1 + x(2))) * x(2) - d * x(3); % x(3) is R
11 dx = dx(:);
12 end

```

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#### 6.simulation.m

```

1  %%
2  % The model with only  $\phi(I) = 1 + I$ 
3  [t, x] = ode45(@model_with_phi, 0:0.001:6, [999, 1, 0]);
4  % subplot(1, 3, 1)
5  plot(t,x)
6  title('S,I,R vs Time, When  $\phi(I) = 1 + I$ ,  $\beta = 1$ ,  $d = 1$ ,  $N = 1000$ ')
7  xlabel('time t');
8  ylabel('# of population');
9  legend('S', 'I', 'R');
10 %%
11 % The model with only  $\phi(I) = 1 + 0.001 * I + 0.001 * I^2$ 
12 [t, x] = ode45(@model_with_phi2, 0:0.001:6, [999, 1, 0]);
13 % subplot(1, 3, 1)
14 plot(t,x)
15 title('S,I,R vs Time, When  $\phi(I) = 1 + 0.001I + 0.001I^2$ ,  $\beta = 1$ ,  $d = 1$ ,  $N = 1000$ ')
16 xlabel('time t');
17 ylabel('# of population');
18 legend('S', 'I', 'R');
19 %%
20 % The model with only  $\phi(I)$  exp
21 [t, x] = ode45(@model_with_phi_exp, 0:0.001:10, [999, 1, 0]);
22 % subplot(1, 3, 1)
23 plot(t,x)
24 title('S,I,R vs Time, When  $\phi(I) = 100 + e^{-I}$ ,  $\beta = 1$ ,  $d = 1$ ,  $N = 1000$ ')
25 xlabel('time t');
26 ylabel('# of population');
27 legend('S', 'I', 'R');
28 %%
29 % The model with only  $r(I)$ 
30 [t, x] = ode23(@model_with_r, 0:0.001:50, [999, 1, 0]);
31 % subplot(1, 3, 1)
32 plot(t,x)
33 title('S,I,R vs Time, When  $r(I) = 0.5 + 0.5 / (I+1)$ ,  $\beta = 0.01$ ,  $d = 1$ ,  $N = 1000$ ')
34 xlabel('time t');
35 ylabel('# of population');
36 legend('S', 'I', 'R');
37 %%
38 % The model with only  $\phi(I)$  &  $r(I)$ 
39 [t, x] = ode45(@model_with_both, 0:0.001:80, [999, 1, 0]);
40 % subplot(1, 3, 1)
41 plot(t,x)
42 title('S,I,R vs Time with Both  $r(I)$  &  $\phi(I)$ ,  $\beta = 0.01$ ,  $d = 1$ ,  $N = 1000$ ')
43 xlabel('time t');
44 ylabel('# of population');
45 legend('S', 'I', 'R');

```