绘制 SIR 模型变化曲线

一、学生信息

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二、问题描述

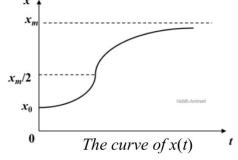
如图 1 所示, 计算并绘制 SIR 模型变化曲线。

Ordinary Differential Equation

· Population Logistic Growth Model

$$\frac{dx}{dt} = r(x)x = rx(1 - \frac{x}{x_m})$$

- r is the per capita rate of increase
- $x_m \text{ is the carrying capacity}$ $x(t) = \frac{x_m}{1 + (\frac{x_m}{x_0} 1)e^{-rt}}$
- The SIR Model for Spread of Disease



- $\frac{di}{dt} = \lambda si \mu i$ S, the susceptible fraction of the population, i, the infected fraction of the population, Homework γ , the recovered fraction of the population. λ , The number of contacts per day that are sufficient to spread the disease
- $\frac{ds}{dt} = -\lambda si$ $\frac{dr}{dt} = \mu i$ Solve the ODE system with the initial: $i(0)=1.27x10^{-6}$, s(0)=1, r(0)=0, with the $i(0) = i_0, \ s(0) = s_0$

parameters $\mu = 1/2$ and $\lambda = 1/3$

Numerical methods for ODEs

图 1 SIR Model

三、实验过程

1. 实验原理

本次实验使用 Matlab 进行实现,用 Euler 算法法进行计算,相关代码见附录。

2. 测试结果

当 μ =1/3,%值 λ =1/2 时,绘制图形如图 2 所示,当 μ =1/2,%值 λ =1/3,绘制图形如图 3 所示。

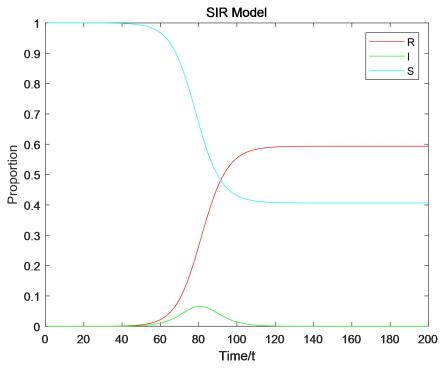


图 2 SIR 模型曲线(μ =1/3,%值 λ =1/2)

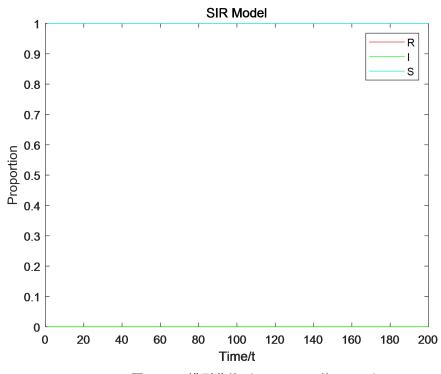


图 3 SIR 模型曲线(μ =1/2,%值 λ =1/3)

四、源代码-Matlab 实现

```
% 设置 SIT Model 初始值
S=[1.0];
I = [1.27*10^{(-6)}];
R = [0.0];
t=200;
% m=1/2;%μ值
% n=1/3;%λ值
m=1/3;%μ值
n=1/2;%λ值
% 计算R、S、I值
for i=2:t
   R(i) = R(i-1) + calculated rdt(m, I(i-1));
   S(i) = S(i-1)-calculatedsdt(n,S(i-1),I(i-1));
   I(i) =
I(i-1)+calculatedsdt(n,S(i-1),I(i-1))-calculatedrdt(m,I(i-1));
end
%绘制 R、S、I 变化曲线
plot(R,'r');
hold on;
plot(I, 'g');
hold on;
plot(S,'c');
legend('R','I','S');
xlabel('Time/t')
ylabel('Proportion')
title('SIR Model')
% 计算 dr/dt=μi
function result = calculatedrdt(m,i)
   result =m*i;
end
% 计算 ds/dt= λ si 的绝对值
function result = calculatedsdt(n,s,i)
   result =n*s*i;
end
```