

A SIMPLE TOY MODEL OF AN EPIDEMIC

THE SIR-MODEL

In the literature (and the internet, of course) many different ways can be found to model mathematically the spreading of a disease. There are plenty of online versions of simulations ,too. A recent one has been presented on the youtube channel NUMBERPHILE– but it is fascinating that this can be done on a ,common‘ pocket calculator like the HP Prime.

One of the most common models is called **SIR**.

Consider a community in which there is a population of N individuals. Initially the community is composed of S_0 **susceptibles**, I_0 **infectives** and R_0 **removed**. The total N is taken to be constant (no births, no deaths), so

$$N = S_0 + I_0 + R_0 = S + I + R$$

The evolution of these values with time is governed by the three differential equations:

$$dS/dt = -\beta SI$$

$$dI/dt = \beta SI - \gamma I$$

$$dR/dt = \gamma I$$

where β (the infection rate) and γ (the removal rate) are non-negative constants.

The program SIR solves the system of equations by numerical integration (Euler Integration) and plots the curves on demand using the plotting facility of the Stat 2Vars app.

Literature:

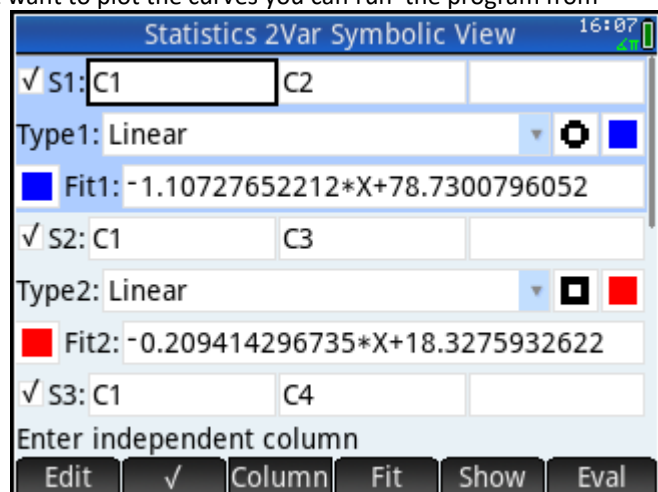
Robert B. Banks

Growth and diffusion phenomena

Springer 1994

HOW TO USE THE PROGRAM SIR

1. Invoke the app **Statistics 2Var**. If you don't want to plot the curves you can run the program from where ever you want.
2. Open the Symb – View and change it accordingly to the screenshot on the right:
Please **check** S1 to S3 and enter the columns C1 to C4. These columns will be filled later by the the program with data of time t , of S , of I and of R .
Choose dot-like marks for scatter plot (unlike the screenshot shows!) in order to obtain as thin curves as possible.
3. Start the program by pressing



Shift + program and by choosing the program SIR from the programs list. Tap on **Run**.

4. Next you will see the input screen:

Here you can enter the **start values** of

S, I, R, the infection rate β , the removal rate γ and the final time (the length of the time interval)

Tap OK to go ahead

5. The program will run and you will see

two sets of data on the text screen: the start values and the values of S, I and R

after TF time units. Now you can re-run the program with new parameters or you can plot the data.

6. To invoke a plot of the evolution of the epidemic change to the Plot-view of the app (press the **Plot** key)
7. Maybe you have to adjust the plot window to see the complete curves. On the handheld calculator this can be achieved by pinching the touch screen.

To change the number of euler steps nstep ($Tf=nstep*dt$) you have to edit the source code.

