Phase Plots for Predator/Prey Equilibrium Graphs

At first glance the Sequence aplet does not seem to offer the ability to produce phase plots which show the relationship between two inter-related sequences, such as that of a predator/prey analysis. However, the addition of the Parametric aplet fills the need.

Eg. Suppose we analyse the predator/prey equilibrium situation between a population of rabbits which are being preyed upon by a population of wolves.

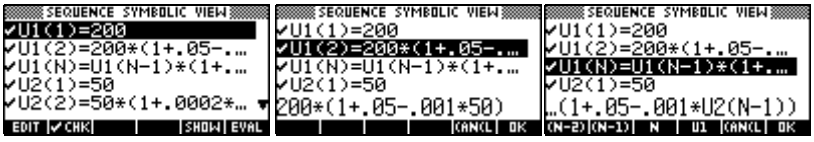
Start with an initial population of 50 wolves and 200 rabbits. The equation for the two populations are:

$$R_n = R_{n-1}\left(1 + M - K \times W_{n-1}\right)$$
$$W_n = W_{n-1}\left(1 + G \times R_{n-1} - D\right)$$

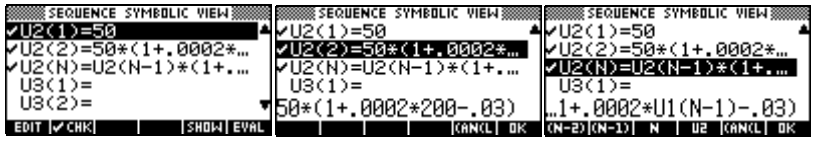
where:

R_n	= number of rabbits at time *n* months.	
W_n	= number of wolves at time *n* months.	
M	= rabbit population growth rate without wolves	(0.05)
K	= rabbit population death rate with wolves	(0.001)
G	= wolf population growth rate with rabbits	(0.0002)
D	= wolf population death rate without rabbits	(0.03)

Use the Sequence aplet to define the two inter-related sequences as shown below. Because most of the definitions are too long to see easily, each of them in turn is shown in the EDIT line. Notice that the values of U1(2) and U2(2) must be calculated from U1(1) and U2(1).

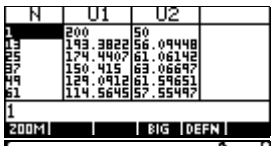


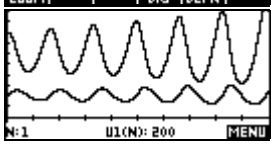
Sequence U1 is R_n.



Sequence U2 is W_n.

Setting the NUM SETUP to start at 1 and go up in steps of 12 months gives a numeric table of results as shown right. Unfortunately the PLOT view can only show the two sequences as separate graphs even if plotted together. The regular fluctuations can be seen but not as clearly their inter-relation. The graph shows N<1000.





The solution is to use the Parametric aplet to produce a phase plot with the U1(N) values on the X axis and the U2(N) values on the Y axis. The equilibrium situation can clearly be seen in the PLOT view shown right. In this case the graph shows a slow outward spiral which demonstrates a population in equilibrium but growing.
A smoother plot can be obtained by setting Tstep to 6 months.