From Generalized Lotka-Voltera (GLV):

Assuming has linear relationship with all species density, except species i and j:

Excluding and from the makes sure the interaction between species i and j, as well as intra-species interactions, are counted by only and will not be further altered by either species i or j’s density.

GLV becomes:

To implement the growth rate in R, assuming a 3-species community with linear dependency of :

Here is implemented as:

Where:

The summation of nth row coefficients correspond to j = n, and the summation of all coefficients correspond to i = n. For i = n, based on the assumption that the self-interaction is captured by , the nth row coefficients (i.e. j = n) should all be 0.

We also made the assumption that the concentration of i and j will not further alters the interaction between i and j in addition to . This means that for the rest rows, = 0 if k = j (i.e. row number) or k = I (i.e. matrix order).

We can show the last term of the R code is indeed the last term of GLV by expanding its matrix form:

The first item above will multiply by and hence 0 for the first column coefficient.

We can also assume a higher order dependency of on all species density:

GLV becomes: