

Dynamics Between Heterogeneous Spending Types in Mobile Gaming

Joshua L. Eubanks

Methodology

For understanding the dynamics between multiple individuals in the mobile gaming industry, I assume a biological model that implements a Lotka-Volterra competition model. In this scenario, two or more species are competing for the same resource and as a result hinder each other's growth. I link this to mobile gaming industry because the different types of spenders are competing over the same resource, a collectible item. Using the model above, I can observe the birth rates, carrying capacity, and the coefficients of competition across different types. One could separate the types by if they spend money on the app or not (spenders and non-spenders) or they can break down the spenders by types (minnows, dolphins, whales, etc.). Separating by spending types would be best implemented by using Jenks' natural breaks instead of similar methods such as K-means because Jenks takes advantage of the fact that one dimensional data (amount spent daily) is sortable. This makes the algorithm quicker than K-means which is better suited for more than one dimension.

Model

The competitive model assumes a logistic growth rate with a finite carrying capacity. This gives rise to the following equation:

$$N_{i,t} = N_{i,t-1} \exp \left(\frac{r_i [K_i - N_{i,t-1} - \sum_j \alpha_{ji} N_{j,t-1}]}{K_i} \right) \quad \text{where } i \neq j$$

from which, from some minor manipulation, obtain:

$$\log \left(\frac{N_{i,t}}{N_{i,t-1}} \right) = r_i - \frac{N_{i,t-1}}{K_i} - \sum_j \alpha_{ji} \frac{N_{j,t-1}}{K_i} \quad \text{where } i \neq j$$

which is the discrete analog to the Lotka-Volterra differential equations. The interpretation of r_i would be the birth rate of the type, K_i would be the carrying capacity, and α_{ji} would be the competition coefficient between the two types.

Data

Since I never obtained the data, I simulate some random normals and show how to implement it given a dataframe. I generate data for 365 days with 5 types.

References

- Hallett, J. G. and S. L. Pimm (1979). Direct estimation of competition. *The American Naturalist* 113(4), 593–600.
- Murray, J. D. (2002). *An introduction*. [electronic resource]. Interdisciplinary applied mathematics: 17. New York ; London : Springer, 2002.
- Pfister, C. A. (1995). Estimating competition coefficients from census data: a test with field manipulations of tidepool fishes. *The American Naturalist* 146(2), 271–291.