Session 2 (CPS 5401_0827)

- A Predator-Prey Model & Data Clustering (Semester-Long Project)
  + Use already existing package
  + Parallelization w/ MPI & OpenMP

- Predator-Prey Model equation:

$Y'(t) = A(Y, \alpha)$:

$$(t) = r_i \left(1 - \frac{Y_i}{K_i}\right) Y_i + \sum_{\substack{j=1 \\ j \neq i}}^{N} \alpha_{ij} Y_i Y_j \quad \text{(For N species)}$$

- Population growth rate models:
  + exponential growth model
  + Growth rate is the diff. b/t the birth rate and the death rate.
  + We worry if as $t \to \infty$, any of the populations will become zero.
  + $\alpha_{ij} < 0$ for predator-prey relation
    $\alpha_{ij} = 0$ for no relation

- Clustering problem
  + Unstable vs. stable matrix
  + Seperate in parameter space.

- Simplification:
  + Not looking for limit cycle, y^*
  + Looking for limit of pop., Y^*
    - At Y^*, $A(Y^*, \alpha) = 0$,
    - Equation sys. reduced to:
      $r_i \left(1 - \frac{Y_i^*}{K_i}\right) + \sum_{j=1, j \neq i}^{\hat{}} \alpha_{ij} Y_j^* = 0, \ \forall i$ (lin. eq.)

+ Use computer sys. to construct linear sys. & solve using linear algebra (LA) package.

+ Jacobian matrix

ex. $\begin{pmatrix} \partial A_1/\partial Y_1 & \partial A_1/\partial Y_2 \\ \partial A_2/\partial Y_1 & \partial A_2/\partial Y_2 \end{pmatrix}$

- Here, a.k.a. community matrix $M(Y^*, \alpha)$ i.e. $\frac{\partial A(Y^*, \alpha)}{\partial Y}$

- $M(Y^*, \alpha)$, stable if all eigenvalues of it are to the left of the complex plane.

· Community matrix.

$$M(Y^*, \alpha) = \begin{bmatrix} -r_1 Y_1^*/K_1 & \cdots & \alpha_{1N} Y_N^* \\ \vdots & \ddots & \vdots \\ \alpha_{N1} Y_1^* & \cdots & -r_N Y_N^*/K_N \end{bmatrix}$$

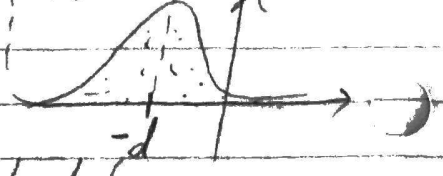
· Generate M (all possible M consist of a set)

+ Generate the diagonal elements of M randomly.

x $M_{ii} \sim -r_i$

x $M_{ii} \sim N(-d, \delta^2)$ (Normal distribution)

• δ is the deviation; tion).



· a_{iN} & a_{Ni} are either both zero or have opposite signs (predator-prey)

+ Probability i & j in predator prey relation, C | $0 \leq C \leq 1$ & probability they are not. $1-C$ | $0 \leq 1-C \leq 1$.
+ M_{ij} poss. $1-C$, $M_{ij} = M_{ji} = 0$
  × $M_{ji} \sim |N(0, \sigma^2)|$

+ 5 parameters: d, δ, C, σ, & N
+ $S = (N, d, \delta, C, \sigma)$ given
  + decide if stable or not
+ Use support vector machine to find rule on S for stable systems.

- Random matrix theory

- Unix Shell Scripting
  + Unix shell is a program that let's us talk to machine in Command Line.
    × It parses the commands
  + Do stuff auto. at following dirs:
    × ~/.bash_login
    × ~/.bash_logout
    × ~/.bashrc
  + This is portability

- links command to navigate web