Numerical Comparative Dynamics: Ball Python Breeding

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ROADMAP OF SEMINAR

1. Snake in a Vacuum
2. Tweak of Becker 1973
3. Problems
4. Approximations
   - Maximize Average Profits
   - Maximize Genes

Snake in a Vacuum

$$\max_{T}\left\{V(T)=\sum_{j=1}^{T}(p\Pi(j)-c)\delta^{j}\right\}$$

Not very close to reality.

Tweak of Becker 1973

Supposing you start with I males and J females, and $I + J$ is less than your total capacity.

$$\max_{\Pi} \left\{ \sum_{t=1}^{\infty} \sum_{i \in I_t} g\left(m_i, f_{\Pi(i)}, t\right) \delta^t \right\}$$
$$s.t. \quad I_t + J_t \leq C$$

where Π maps to possible subsets of 5 or less elements of the set of females J_t, and C is the capacity.

Problems

- Not PAM.
- g may be a profit function, but there doesn't seem to be a closed form for Π
- Brute force method is $\mathcal{O}(IJ^4)$ in each period.

Approximations

Maximize Average Profits

$$
\max_{\mathbf{X},\mathbf{y},\mathbf{z}} \left\{ \sum_{i \in I} \mathbf{r}_i \mathbf{x}_i^T - 80\mathbf{y}^T \mathbf{1}_I - 80\mathbf{z}^T \mathbf{1}_J \right\}
$$

$$
\begin{aligned}
s.t.\quad & \mathbf{X}\mathbf{1}_J \leq 5\mathbf{1}_I \\
& \mathbf{X}^T \mathbf{1}_I \leq \mathbf{1}_J \\
& \mathbf{X}\mathbf{1}_J \leq M\mathbf{y} \\
& \mathbf{X}^T \mathbf{1}_I \leq M\mathbf{z} \\
& \mathbf{y}^T \mathbf{1}_I + \mathbf{z}^T \mathbf{1}_J \leq 15 \\
& X_{ij}, y_i, z_j \in \{0, 1\}
\end{aligned}
$$

Maximize Weighted Number of Genes

This is what snake breeders actually do, and I implemented it as follows:

$$
\begin{aligned}
\max_{\mathbf{X},\mathbf{y},\mathbf{z}} & \left\{ \sum_{i \in I} g_i x_i^T \right\} \\
s.t. \quad & \mathbf{X}\mathbf{1}_J \leq 5\mathbf{1}_I \\
& \mathbf{X}^T\mathbf{1}_I \leq \mathbf{1}_J \\
& \mathbf{X}\mathbf{1}_J \leq M\mathbf{y} \\
& \mathbf{X}^T\mathbf{1}_I \leq M\mathbf{z} \\
& \mathbf{y}^T\mathbf{1}_I + \mathbf{z}^T\mathbf{1}_J \leq 15 \\
& X_{ij}, y_i, z_j \in \{0, 1\}
\end{aligned}
$$