Lefkovitch Method

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Note

Adapted from Levkovitch(1963, 1964 a,b) study on cigarette beetle. From page 142 in Caswell book

Linear Regression

```
for (i in 1:nrow(A_reg)){
  #calc each row of mtx and add to A
  y <- matrix(observedStageMatrix[2:11, i])
  arow <- inv((t(x) %*% x)) %*% t(x)  %*% y
  A_reg[i, ] <- arow

  #now make vectors for sd and var
  e <- matrix(y - x %*% arow)
  SD[i] <- (t(e) %*% e) / (nrow(y)-nrow(arow))
  Var[i] <- SD[i] * inv(t(x) %*% x)

}
```

Calculated A matrix

$$\begin{bmatrix} 62.4289410362764 & -0.165412586160127 & -0.290906991709686 & 4.79678873229631 & 16.1320389202244 \\ 23.9464749416501 & 0.0668993411294911 & 0.0920252697981245 & 0.0038879785987504 & 4.61862422999329 \\ -0.740995476864647 & -0.0288748596975758 & 0.179891792182946 & 0.450432832183891 & 0.861290553726353 \\ 2.49110066305675 & 0.0080737735619273 & -0.0541865730319383 & 0.10698411628036 & -0.773731794330343 \end{bmatrix}$$

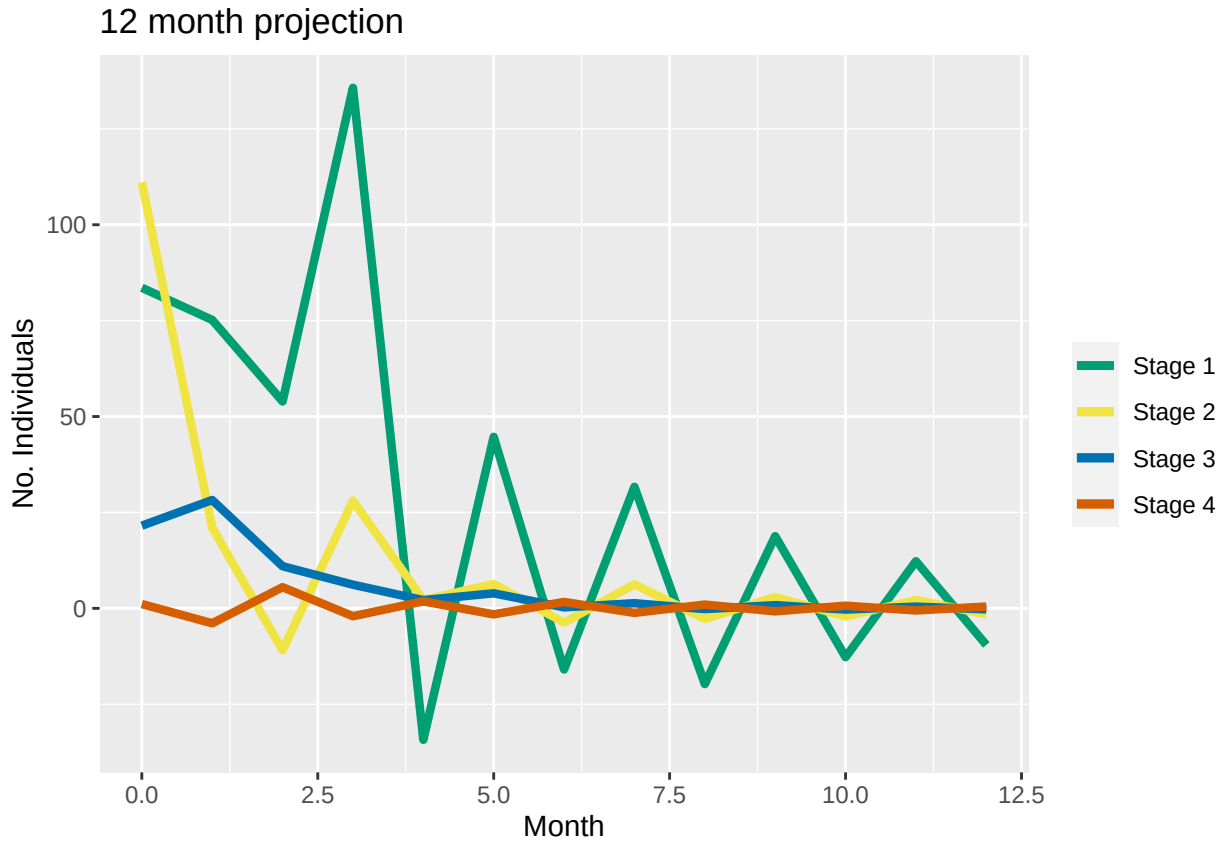
SD of matrix

$$\begin{bmatrix} 534.908512607629 \\ 230.081486173226 \\ 15.338620720261 \\ 0.543929404077961 \end{bmatrix}$$

Variance of matrix

$$\begin{bmatrix} 876.492219975721 \\ 377.007708492408 \\ 25.1336095978881 \\ 0.891273703172627 \end{bmatrix}$$

Matrix and Predictions



Removing Negatives

A matrix-negatives removed

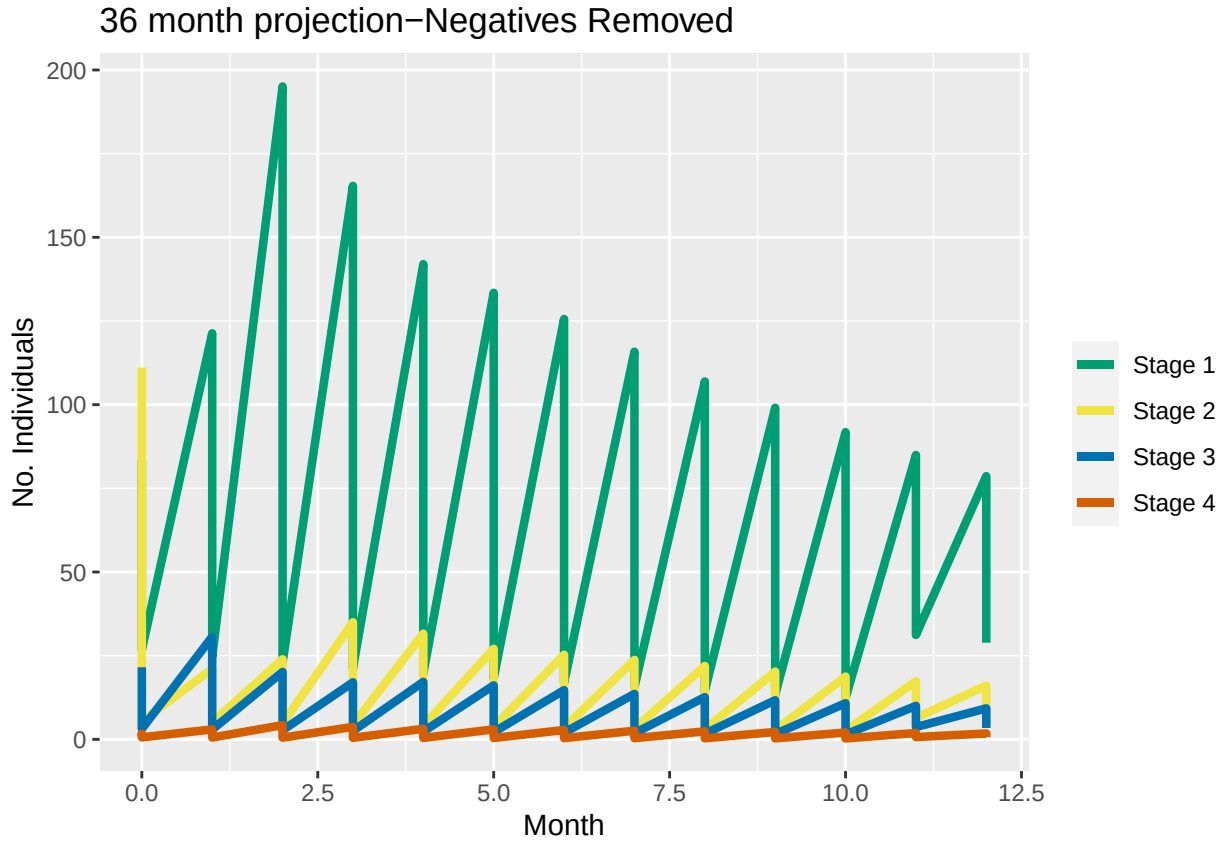
$$\begin{bmatrix} 62.4289410362764 & 0 & 0 & 4.79678873229631 & 16.1320389202244 \\ 23.9464749416501 & 0.0668993411294911 & 0.0920252697981245 & 0.0038879785987504 & 4.61862422999329 \\ -0.740995476864647 & 0 & 0.179891792182946 & 0.450432832183891 & 0.861290553726353 \\ 2.49110066305675 & 0.0080737735619273 & 0 & 0.10698411628036 & 0 \end{bmatrix}$$

SD of A matrix-negatives removed

$$\begin{bmatrix} 1527.40253935222 \\ 191.734571811022 \\ 23.8862882441369 \\ 13.7905589327085 \end{bmatrix}$$

Var of A matrix-negatives removed

$$\begin{bmatrix} 2502.77647664845 \\ 314.17309041034 \\ 39.1396758821836 \\ 22.5969812196691 \end{bmatrix}$$



Next Steps:

1. This model doesn't include the b0 values by adding an extra column of 1's to beginning of X mtx
2. Try Caswell and Twombly Method (1989) from 143 of Caswell book
3. Try Wood's Quadratic Programming Method 6.2.2 from pg 144 of Caswell book
4. Try to force certain aij's to be zero
5. Look into measuring fecundity and how to deal with maturity btwn T and T+1 (section 6.7)
6. Other tings: Picking timestep, See ch 7 if our timescale is too big (right now this is months for shiggles). If one stage is shorter than timestep, then pi = 0
7. Once you think you have a good model, go back over ch4 for all the stuff you can actually do with that