

Team 4 : Population Dynamics

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Outline

Lokta-Voletra!

Real-World Factors

Implementation

Conclusion

Predator-Prey “Relationship”¹



¹[www.alaskapublic.org,en.wikipedia.org](http://www.alaskapublic.org/en.wikipedia.org)

Predator-Prey Model

Coupled ODE's describing behavior of predator & prey populations.

$$\frac{dM}{dt} = br_M * M - df_M * M * W \quad | \quad \frac{dW}{dt} = br_W * W * M - df_W * W$$

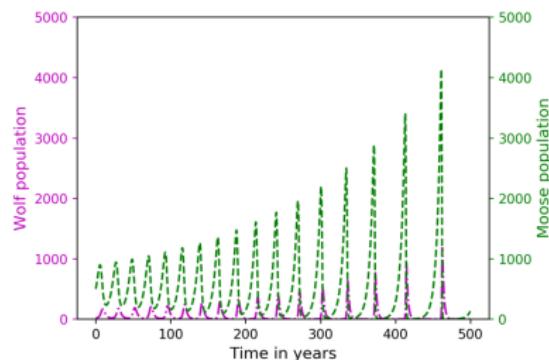
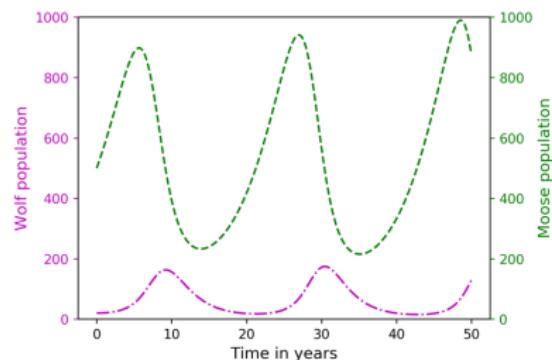
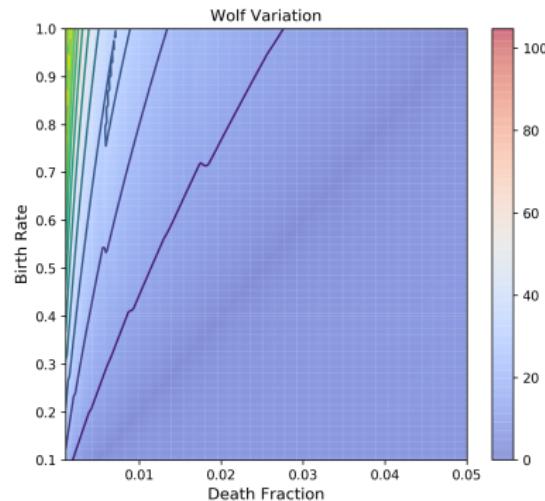
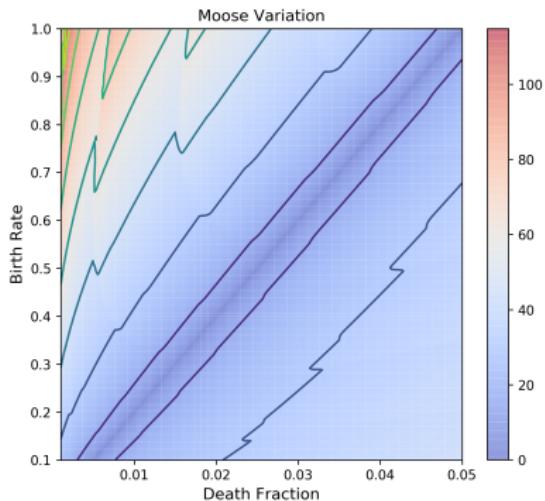


Figure: Stability analysis

Sensitivity to Moose Birth and Death rates

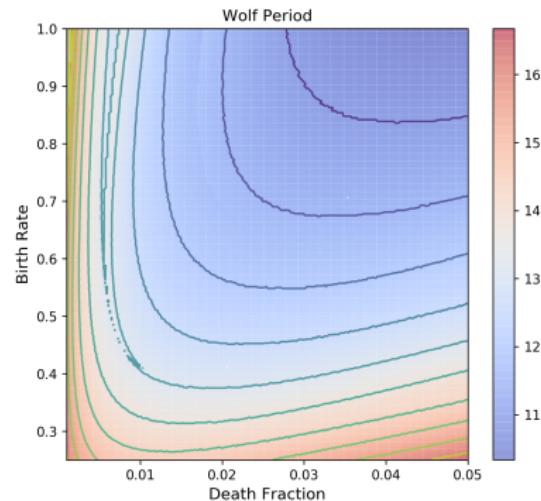
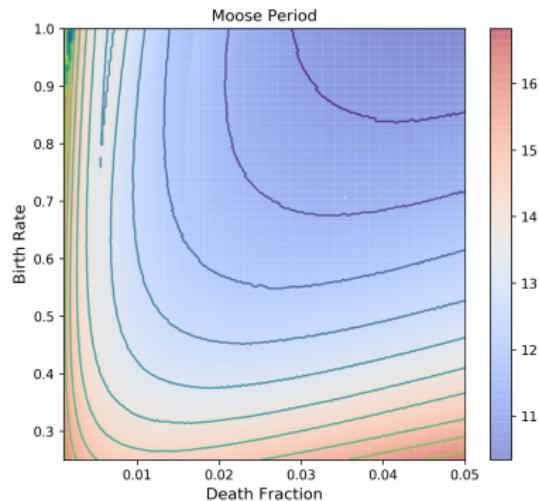
'Amplitude' plots for Moose and Wolf populations.²



²Square root of quantities visualized for enhanced contrast

Sensitivity to Moose Birth and Death rates

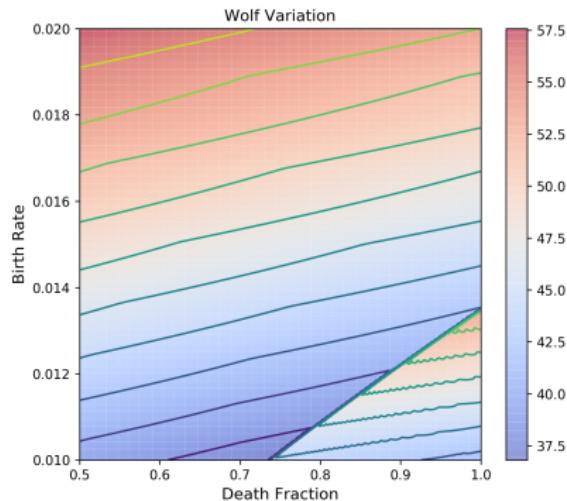
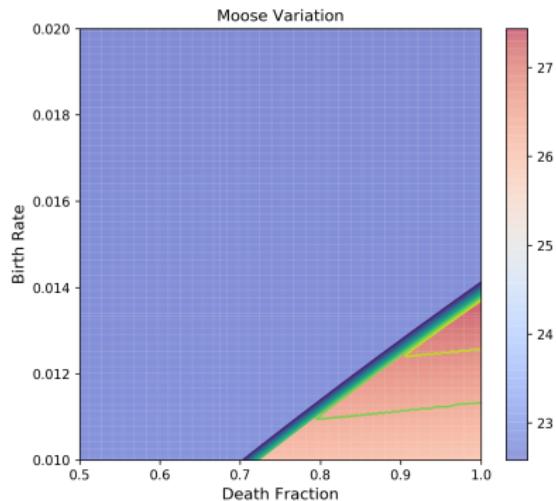
'Period' plots for Moose and Wolf populations.³



³ Square root of quantities visualized for enhanced contrast

Sensitivity to Wolf Birth and Death rates

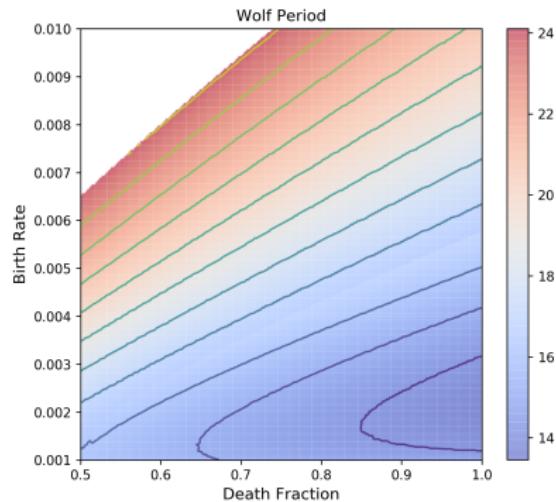
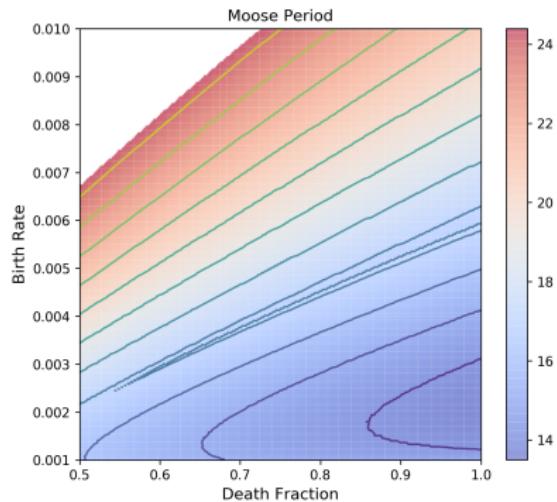
'Amplitude' plots for Moose and Wolf populations.⁴



⁴ Square root of quantities visualized for enhanced contrast

Sensitivity to Wolf Birth and Death rates

'Period' plots for Moose and Wolf populations.⁵



⁵ Square root of quantities visualized for enhanced contrast

Model Carrying Capacity

- ▶ What is carrying capacity ?
- ▶ Which plot ?

Explaining real world data

- ▶ We can fit our model to real world data
- ▶ Which plot ?

Language & Libraries!

- ▶ Libraries :
 - ▶ Numpy/Scipy : Arrays and Fit functions
 - ▶ Matplotlib : Visualization
 - ▶ Pandas : Dataframes
- ▶ How to HPC ?
 - ▶ Numexpr : Fast expression evaluation, to optimize code
 - ▶ Joblib : Parallel execution module
 - ▶ HDF5 : Structured I/O for scalable performance.
 - ▶ More science ! ?

Conclusion

- ▶ And thus an important project was undertaken.
- ▶ Thank you to the organizers of PEARC19!