1 Rough Draft of Paper

1.1 Introduction

Introduce the background of paper. Includes some basic introduction of Pomp, PanelPOMP and experiment of Duffy Lab. Also, this part will show the outline of the paper.

1.2 Data Description

Introduce the experiment of Duffy Lab. And includes description of data, which contains data for different level of experiments.

1.3 Mechanistic Models

Includes several models that can be used for Daphnia Data, such as PanelPOMP models and Bayesian models. Those models should be used for panel data of three different levels.(Only Daphnia, One sepcies of Daphnia and Parasite, Two species of Daphnia and Parasite)

1.4 Statistical Analysis

Includes description of Iterated Filtering algorithms and Approximate Bayesian computation. Then showing the estimation of parameters of different methods.

1.5 Results

Showing and comparing the results.

1.6 Discussion

Discuss the pro and cons of PanelPOMP models comparing to other models.

2 Temporary Model

This part includes the temporary model for the dynamic system that only includes one species of Daphnia, alga and parasite. I've discussed this model with Professor King and made some modification.

$$
\begin{aligned}
dS &= rF\left(S+\xi I\right)\left(1-\frac{S+I}{K_S}\right)dt-\theta_S S dt-pf_S SP dt-\delta S dt+S d\zeta_S,\\
dI &= pf_S SP dt-\theta_I I dt-\delta I dt+I d\zeta_I,\\
dF &= \alpha F\left(1-\tfrac{F}{K_F}\right)\cdot dt+F d\zeta_F-\gamma F\left(S+\xi I\right)\cdot dt-\delta F\cdot dt+\mu\cdot dt,\\
dP &= \beta\theta_I I dt-f_S SP dt-f_I IP dt-\theta_P P dt-\delta P dt+P d\zeta_P.
\end{aligned}
$$

Where temporarily, we assume:

$$d\zeta_F \sim N\left(0, \sigma_F^2 dt\right)$$
$$d\zeta_S \sim N\left(0, \sigma_S^2 dt\right)$$
$$d\zeta_I \sim N\left(0, \sigma_I^2 dt\right)$$
$$d\zeta_P \sim N\left(0, \sigma_P^2 dt\right)$$

We describe Normal distribution with mean and variance here. And r is maximum exponential growth rate for Daphnia, ξ is reduction in infected host reproduction,K_S is carrying capacity for healthy Daphnia, p is probability of infection per spore, f_S is susceptible host filtering rate, δ is sampling rate, θ_S is mortality rate of suspected Daphnia, θ_I is mortality rate of infected natives, α is maximum exponential growth rate for alga,K_F is carrying capacity for alga, γ is the consumption rate of alga by Daphnia, μ is the alga refill rate, β shows spores produced per Daphnia,θ_P is the spore degradation rate. And $d\zeta_F, d\zeta_S, d\zeta_I, d\zeta_P$ are Brownian noise term.