

EEID Ant Grant Research Presentation

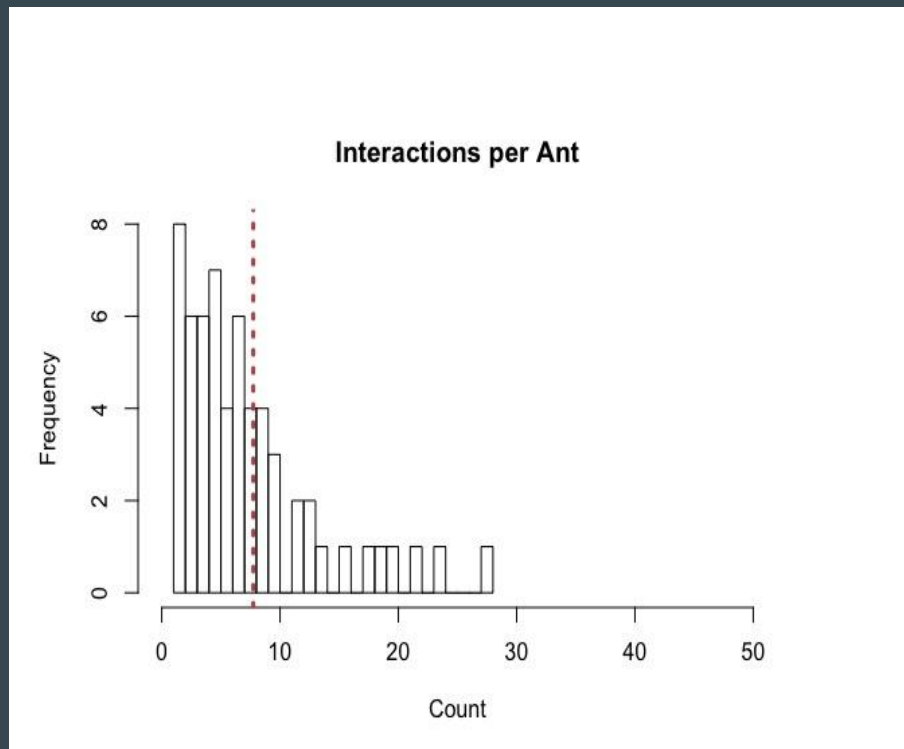
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Statistics Department
Advisor: Ephraim Hanks

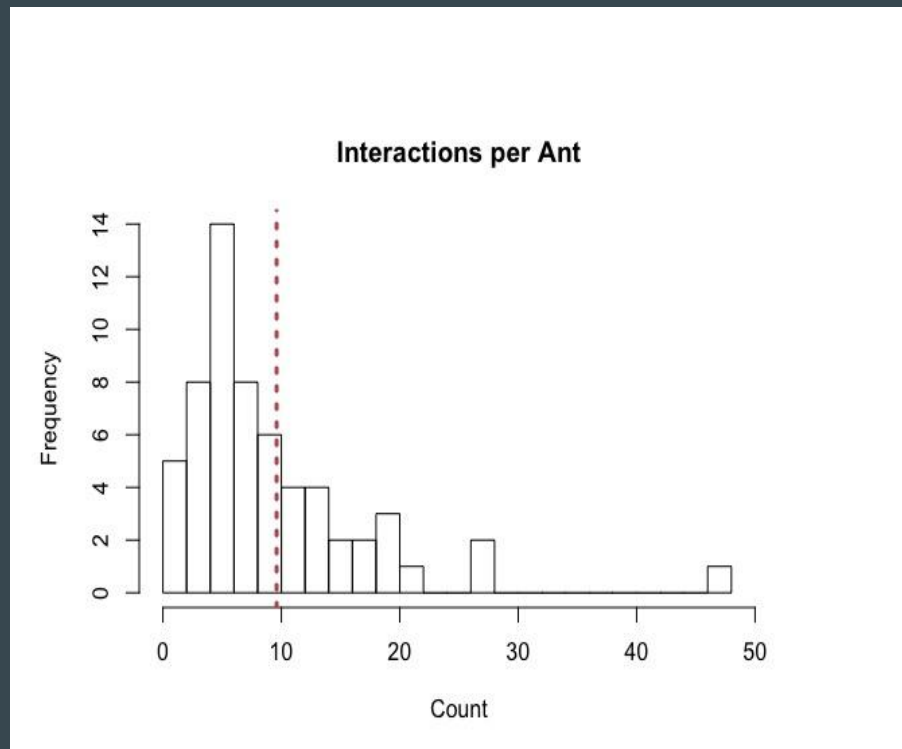
Project Summary

- Data includes two, four and twelve hours of continuous ant trophallaxis observations
 - High density (1 chamber) & low density (4 chambers)
 - 4 hour forager entrance times also obtained
- Discrete time, hidden state MCMC Model used to identify two - state rate switching occurrences at colony level
 - three state model also considered and discarded
- Future work: explore interaction model at individual level
 - Covariates: distance to nearest ant, time since forager entered chamber

Number of Interactions per Ant - 2 Hours

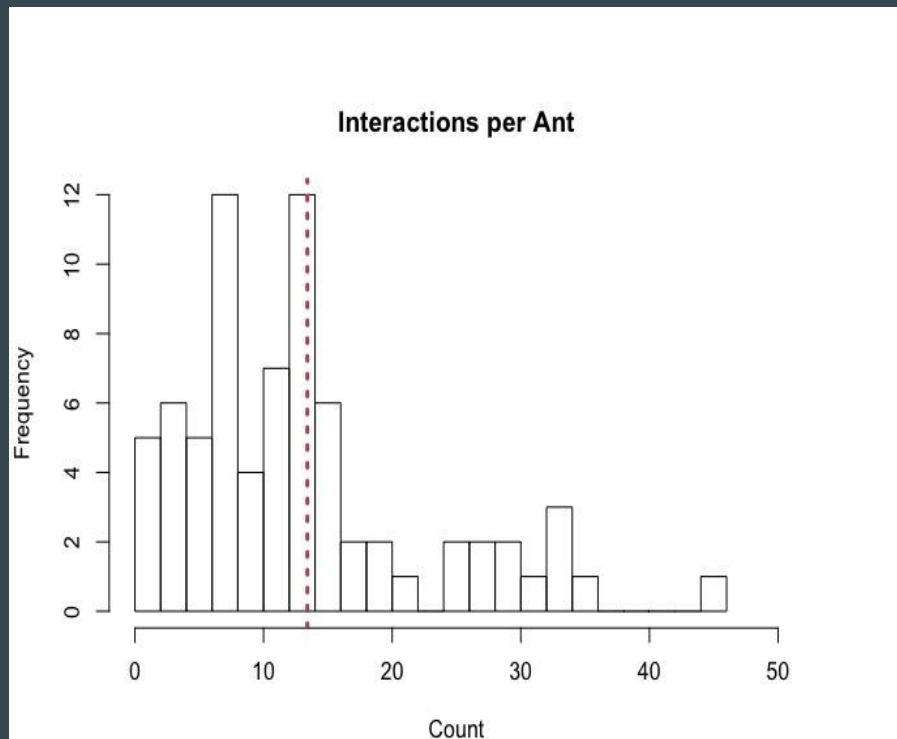


High Density

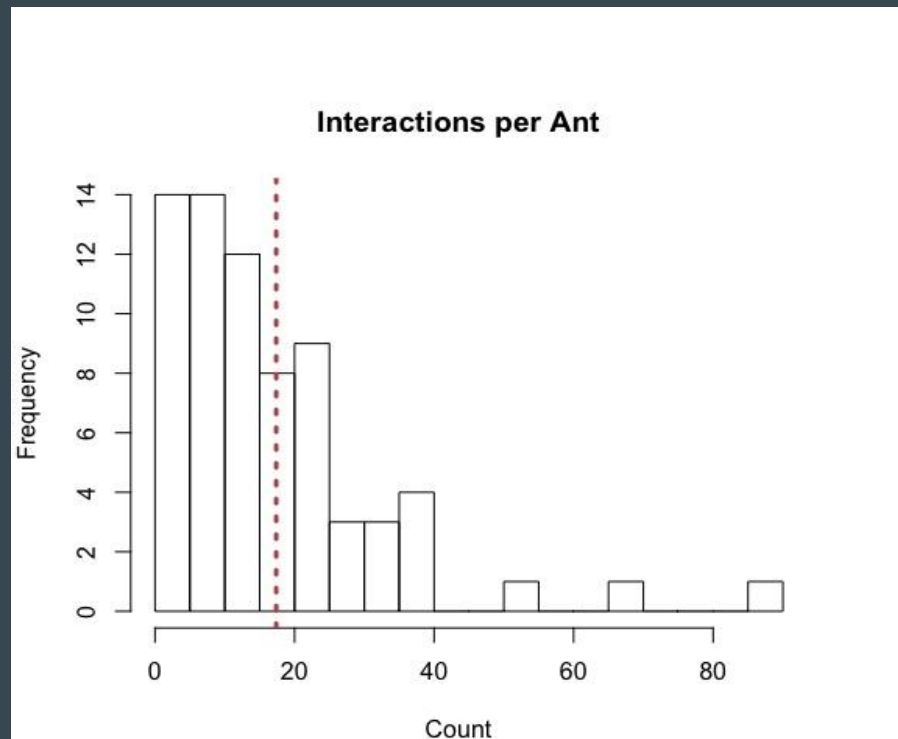


Low Density

Number of Interactions per Ant - 4 Hours

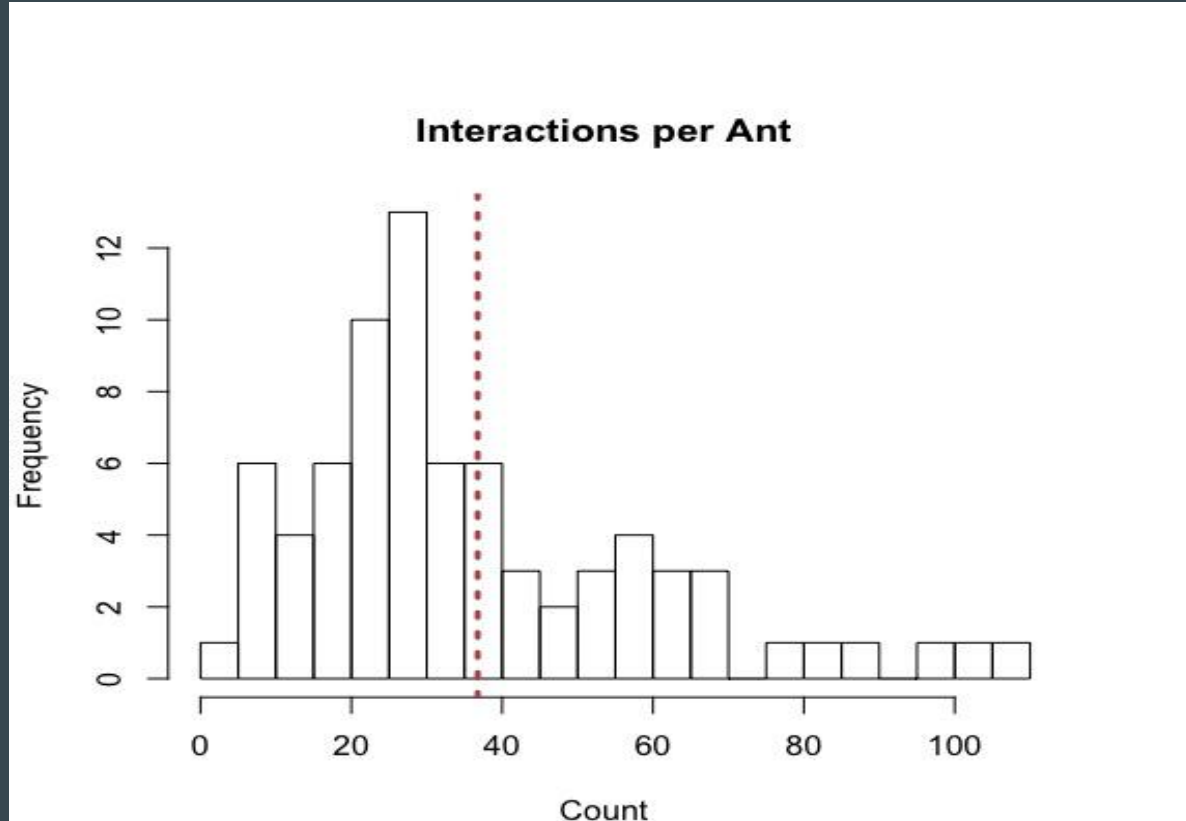


High Density

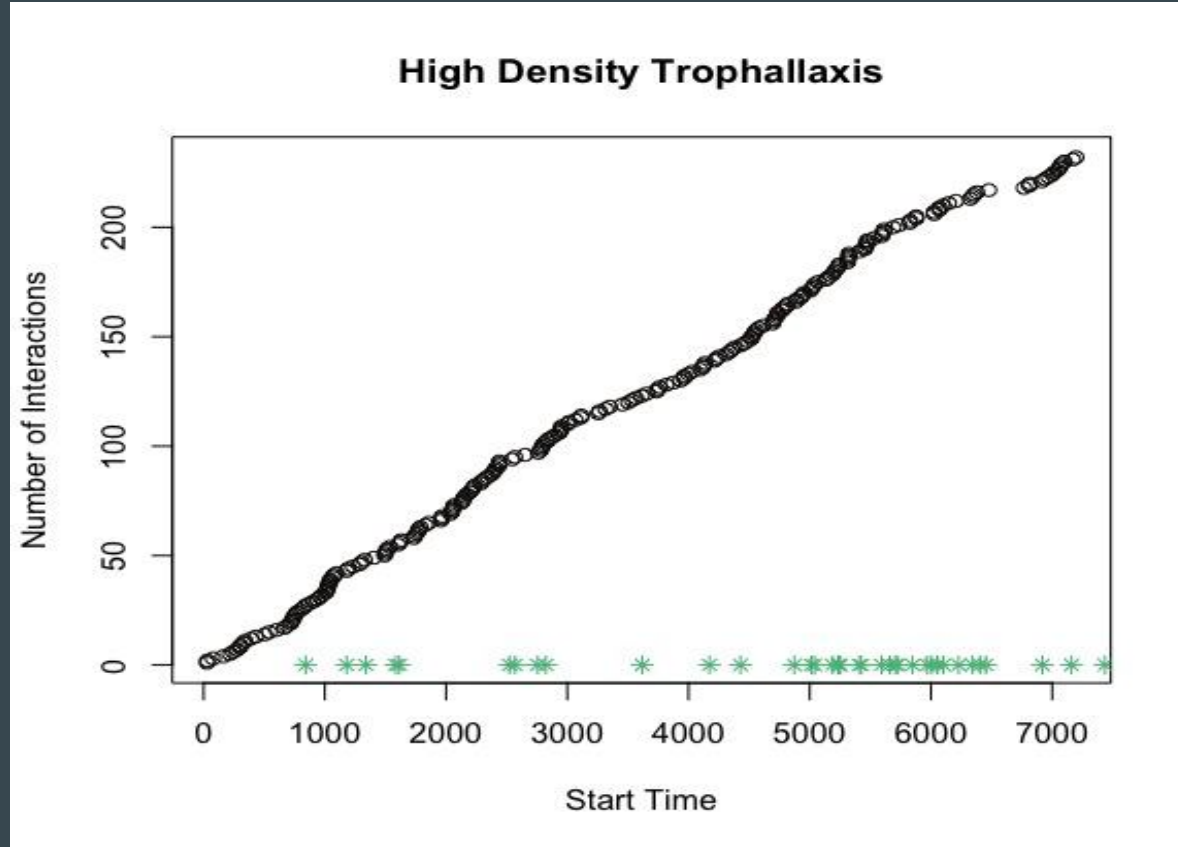


Low Density

Number of Interactions per Ant - 12 Hours



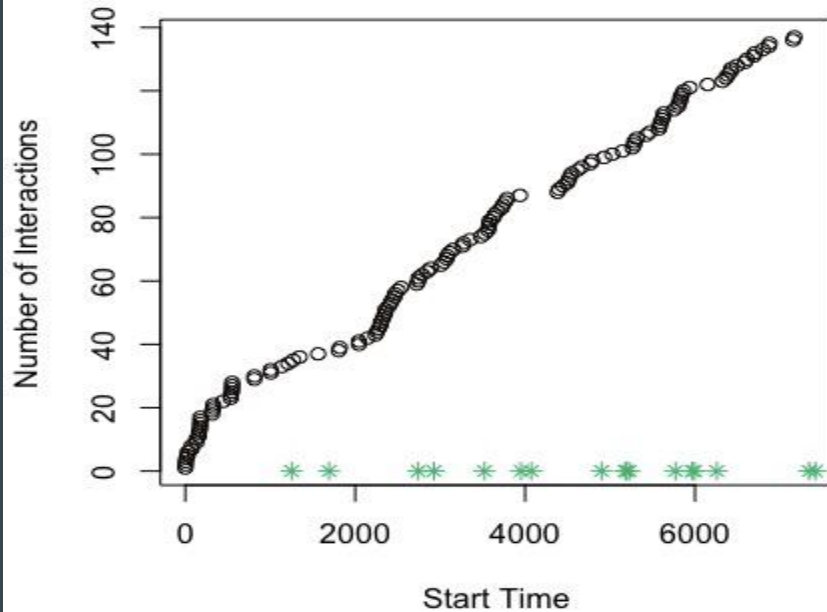
Interactions Over Time - 2 Hours



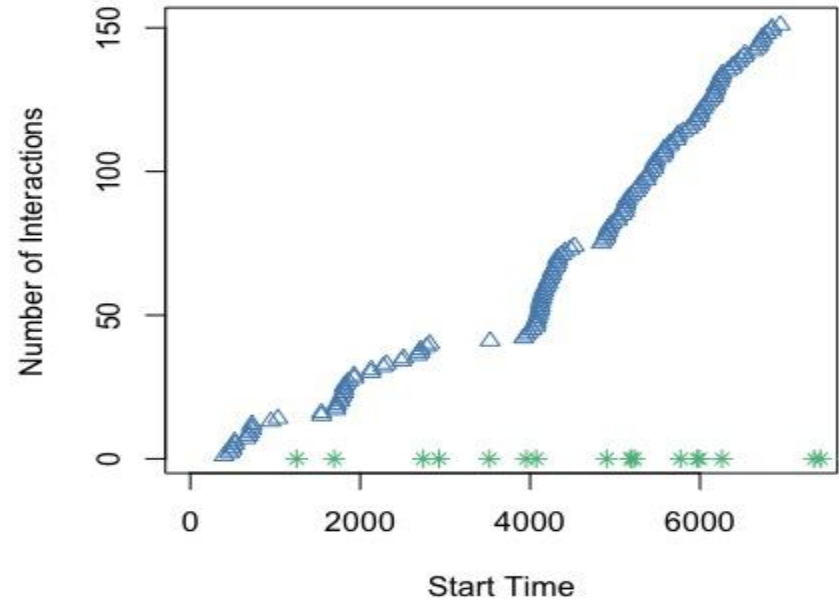
Interactions Over Time - 2 Hours

Low Density Trophallaxis

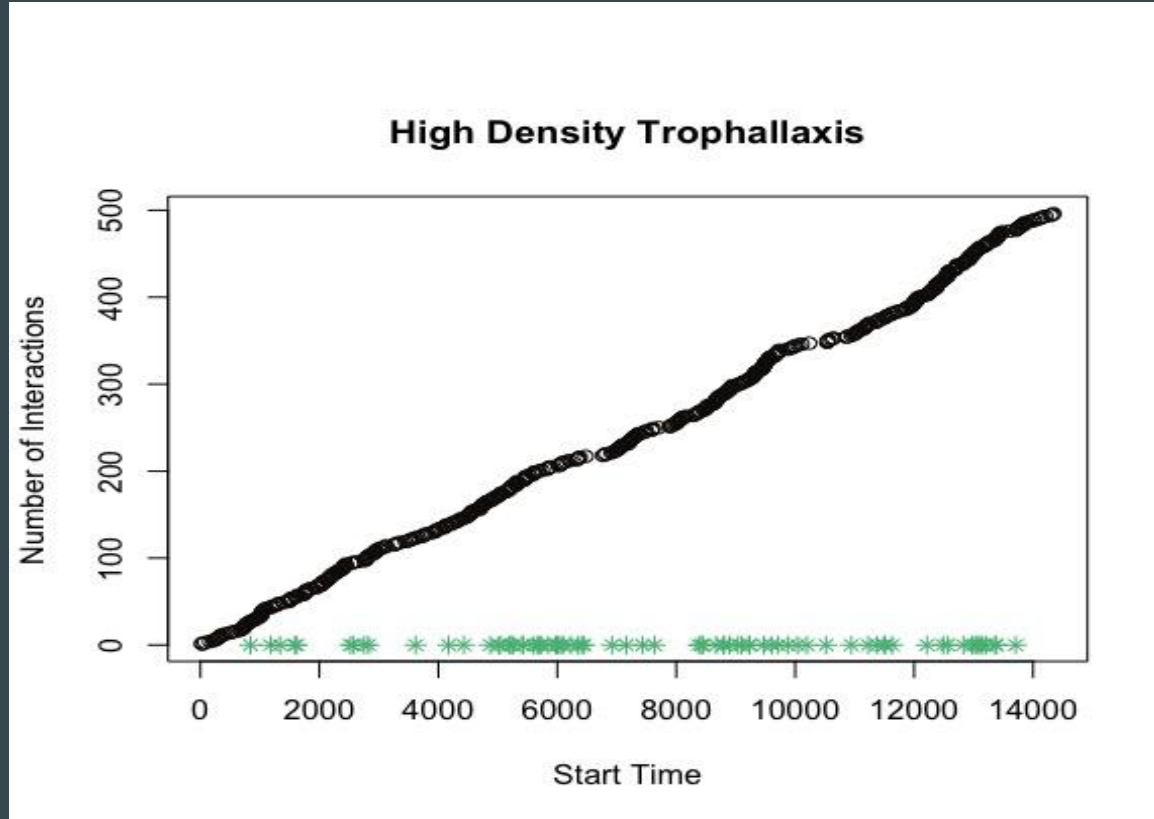
Location 1



Location 4



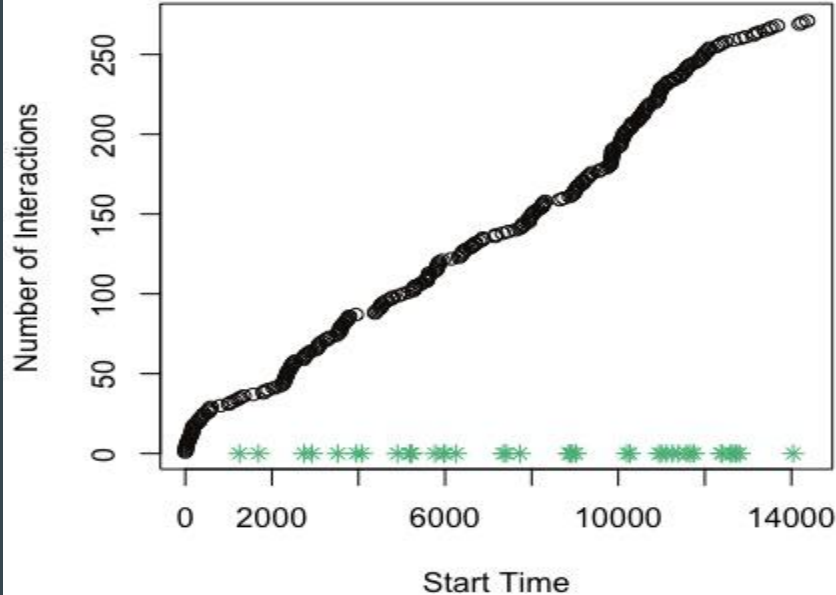
Interactions Over Time - 4 Hours



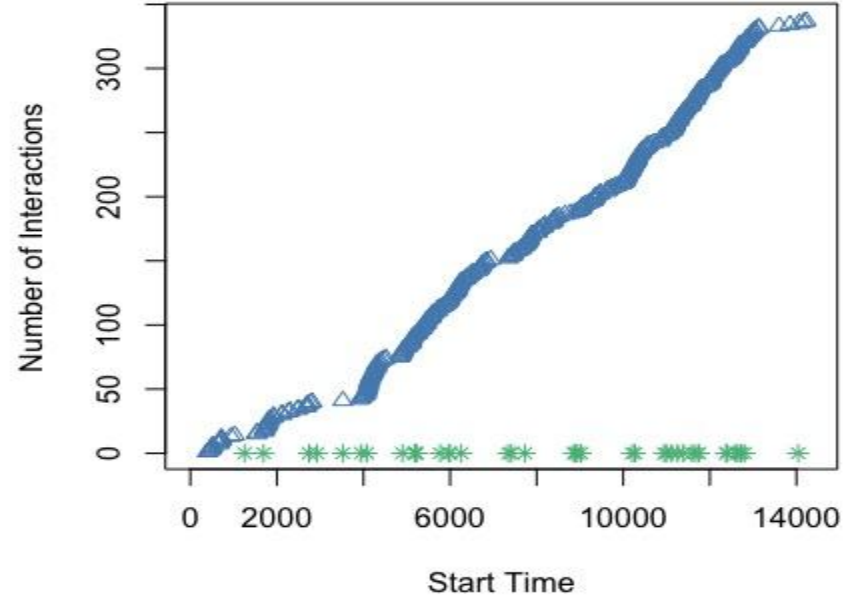
Interactions Over Time - 4 Hours

Low Density Trophallaxis

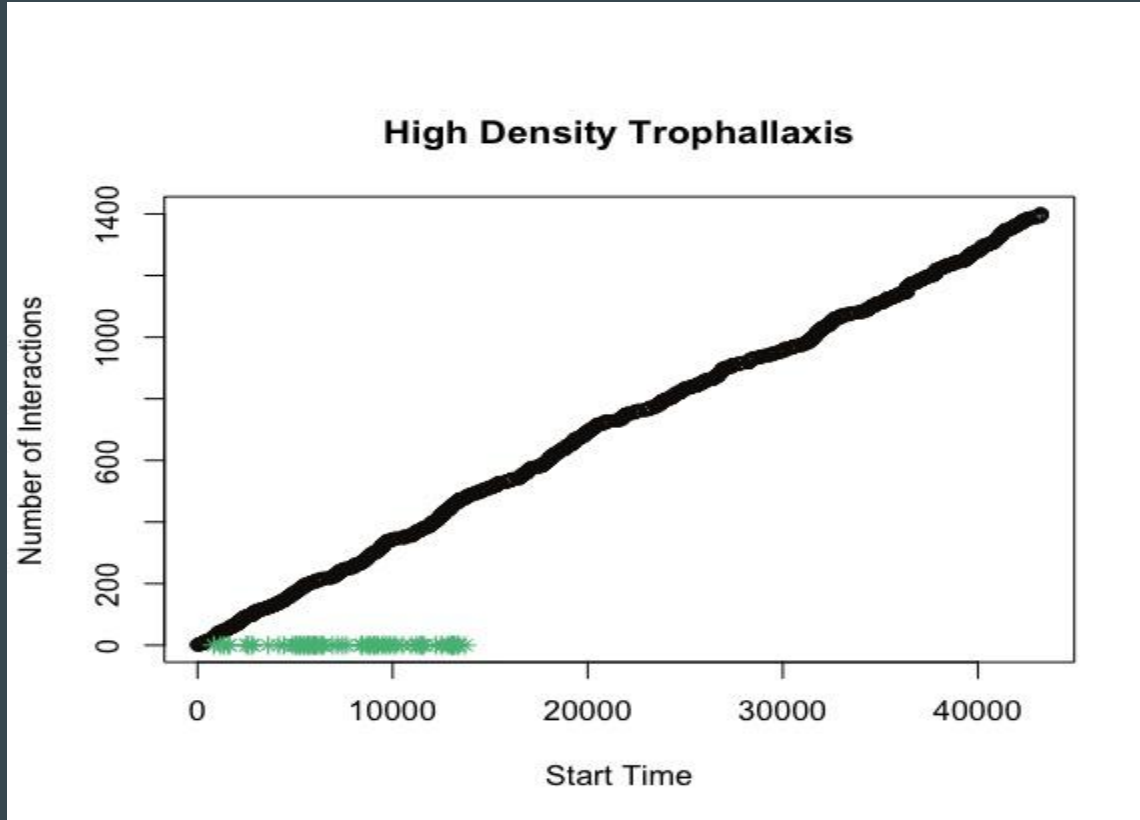
Location 1



Location 4



Interactions Over Time - 12 Hours



Hidden Markov Model for Trophallaxis Interactions

Observed Interactions: $N_t \sim \text{Pois}(\lambda_{X_t})$

Unobserved States: $X_t | X_{t-1} \sim \text{Multinom}(1, p_{X_{t-1}})$

where,

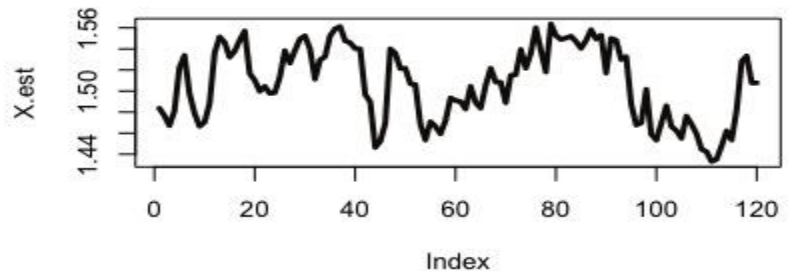
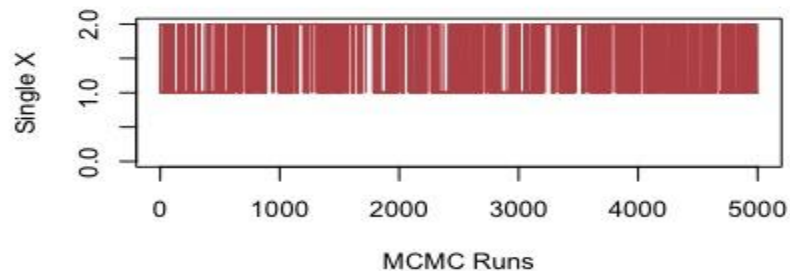
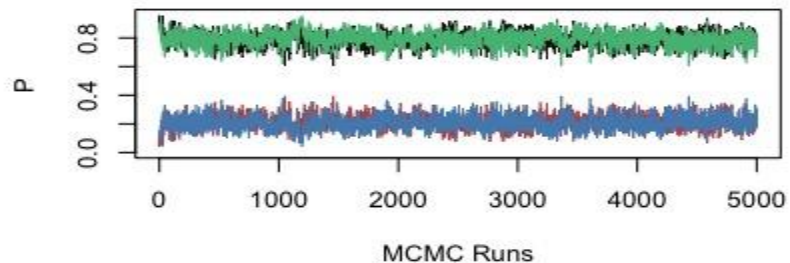
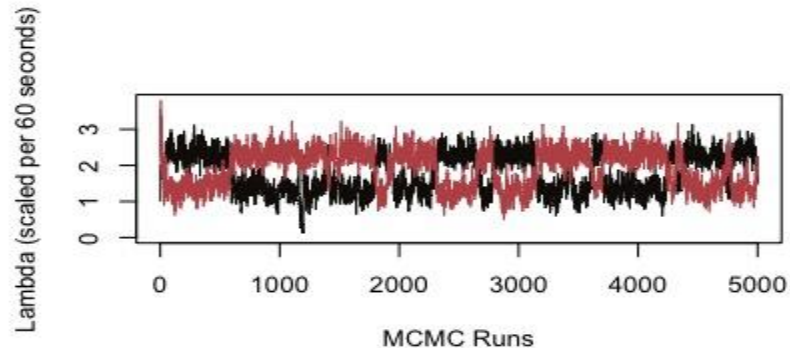
$$P = \begin{array}{|c|c|} \hline p_{11} & p_{12} \\ \hline p_{21} & p_{22} \\ \hline \end{array}$$

$\lambda_{X_t} \sim \text{Gamma}(\alpha, \beta)$

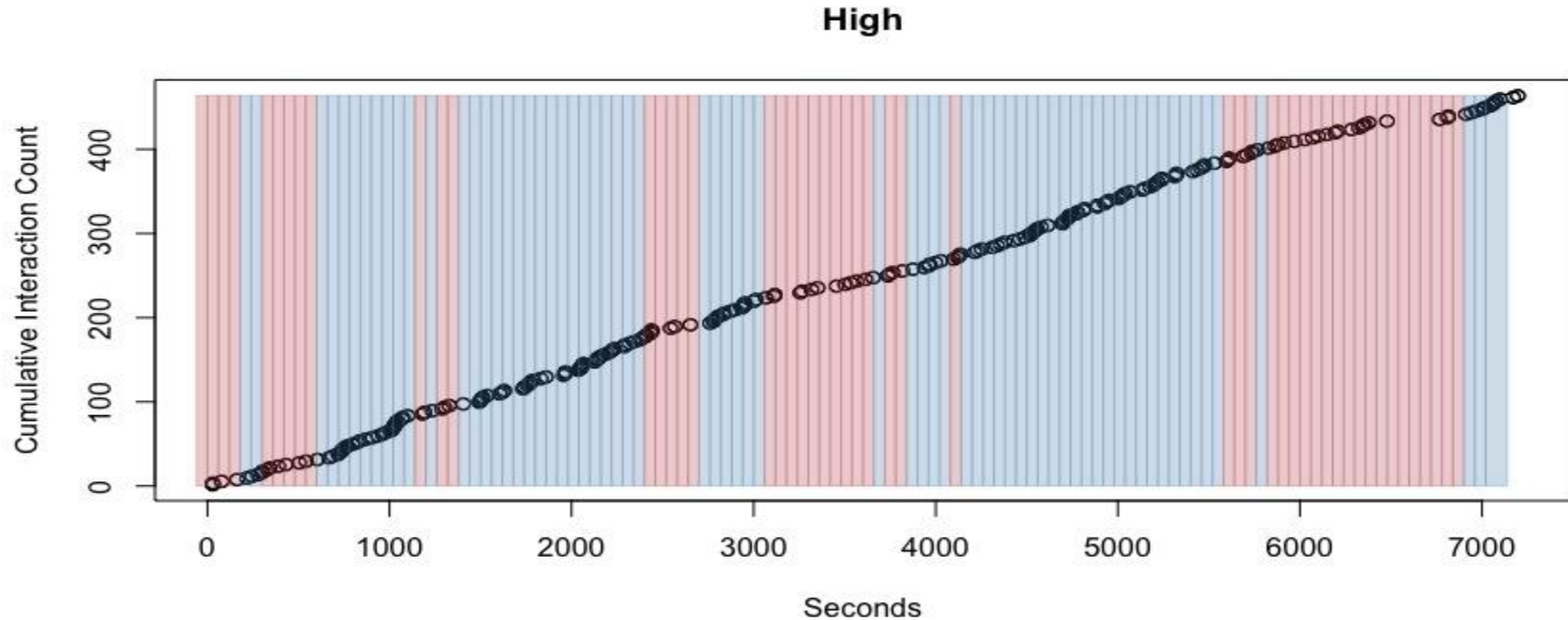
$p_{X_t} \sim \text{Dirichlet}(\underline{\theta})$

MCMC - High Density, 2 Hours

High Density, 2 Hours

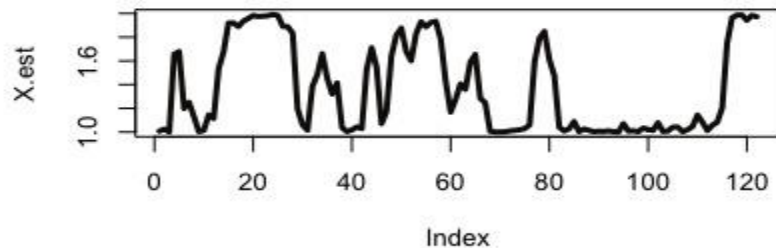
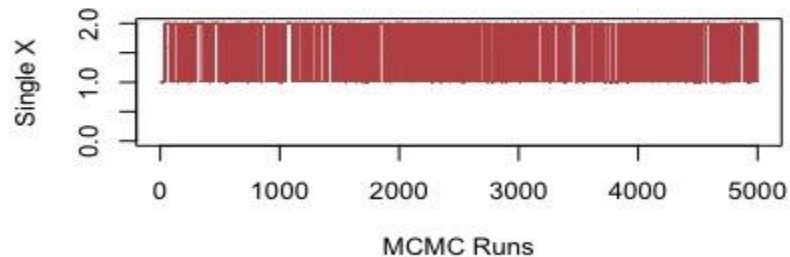
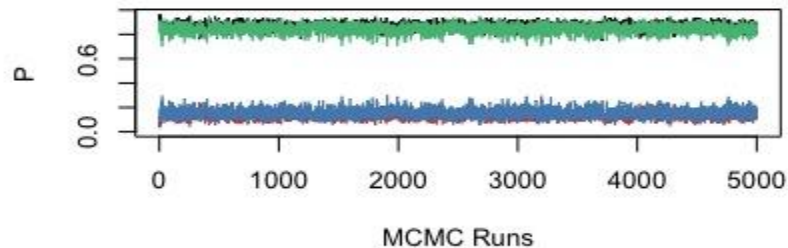
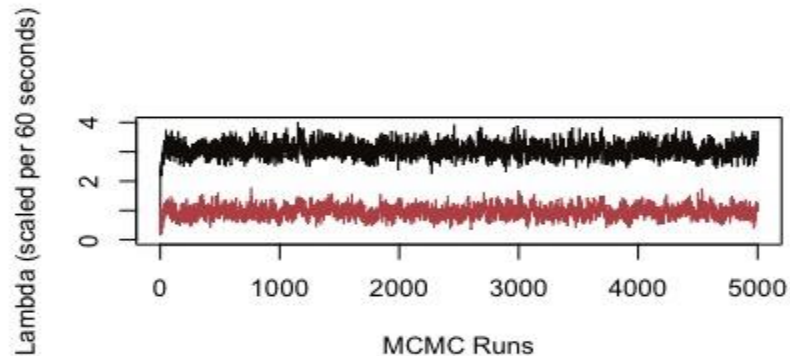


Predicted Trophallaxis Rates - High Density, 2 Hours

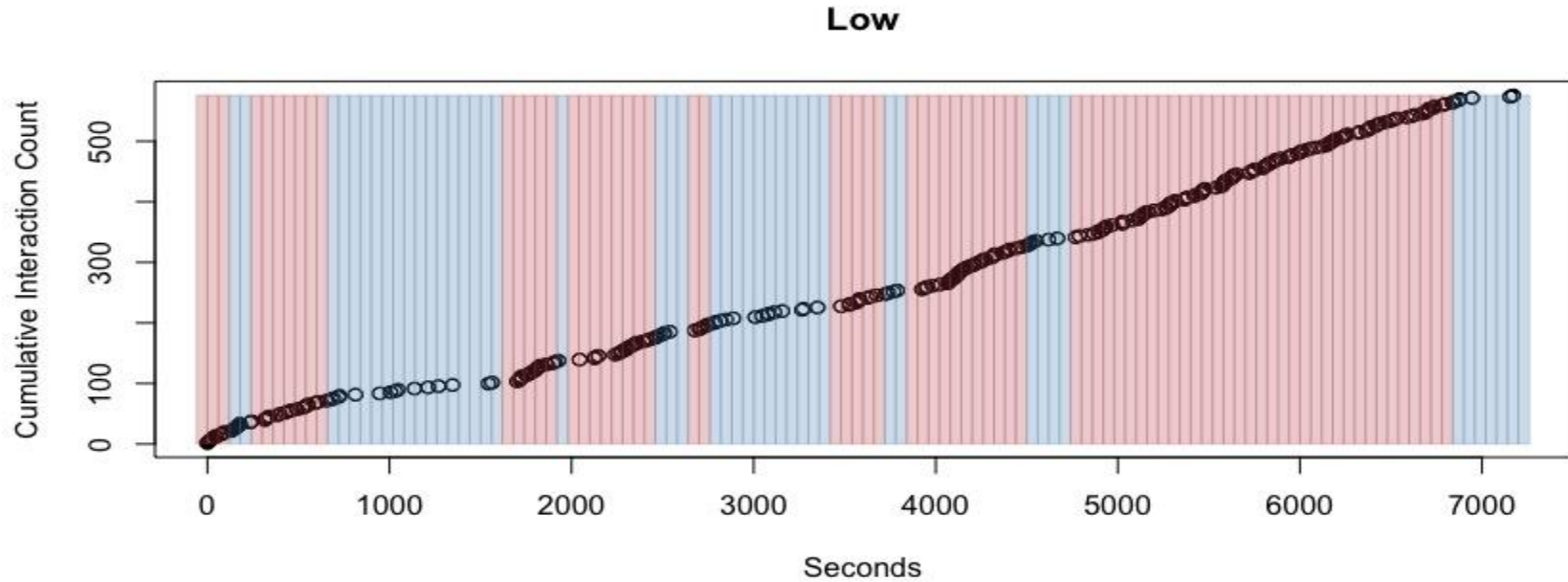


MCMC - Low Density, 2 Hours

Low Density, 2 Hours

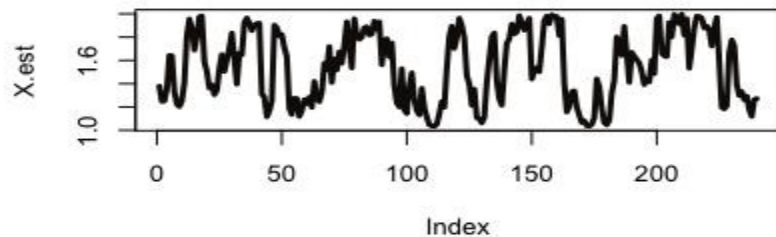
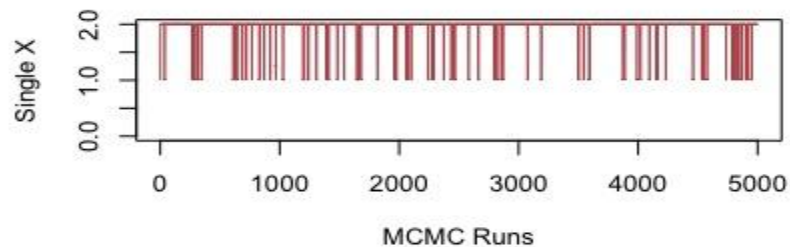
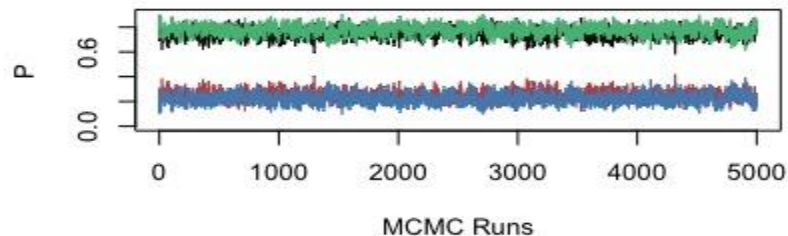
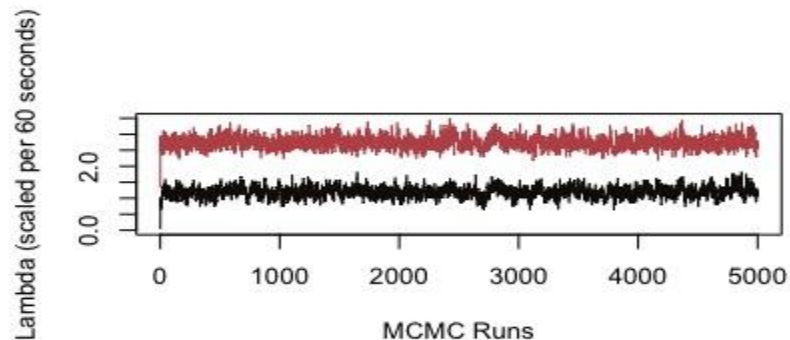


Predicted Trophallaxis Rates - Low Density, 2 Hours

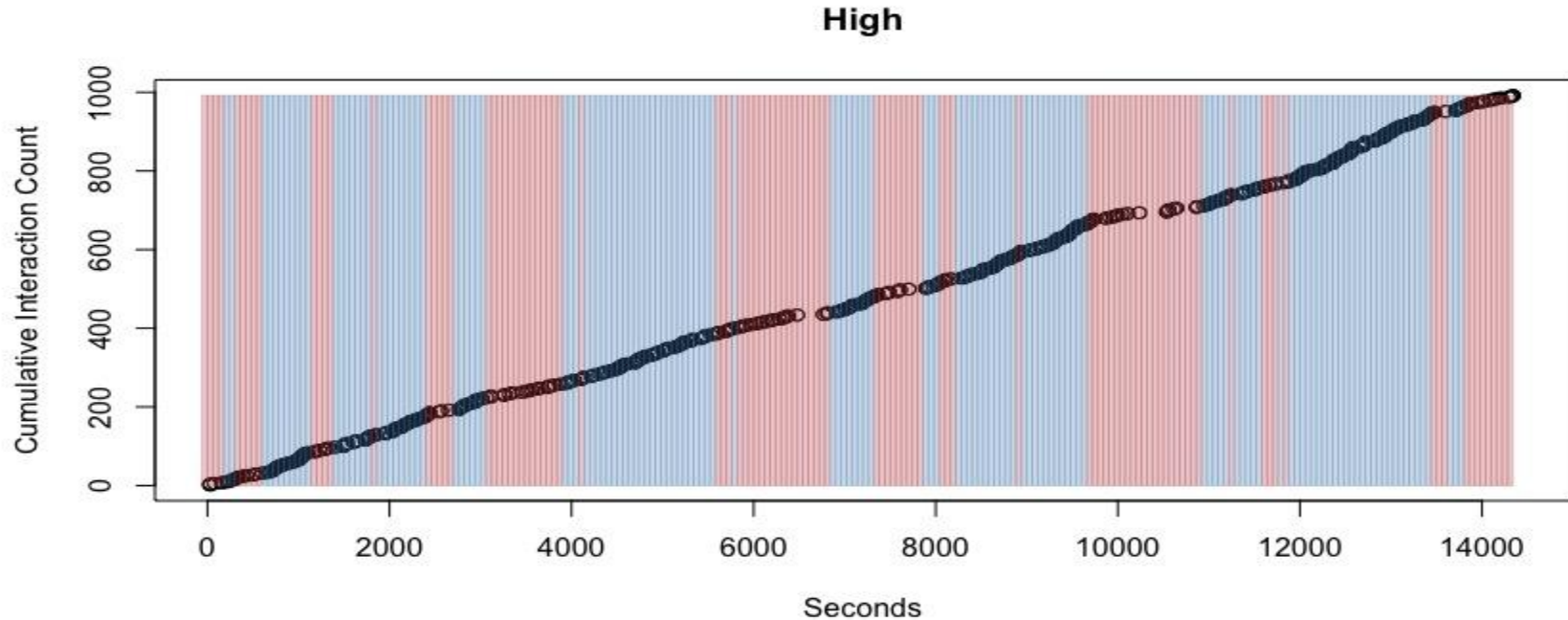


MCMC - High Density, 4 Hours

High Density, 4 Hours

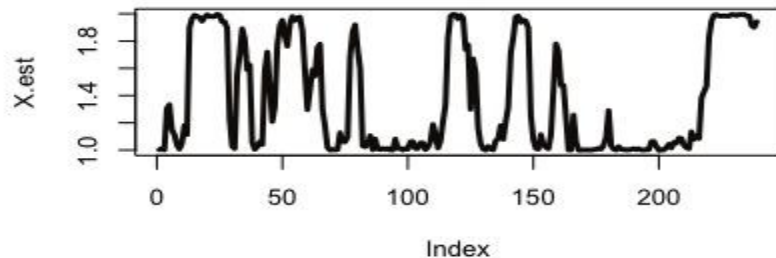
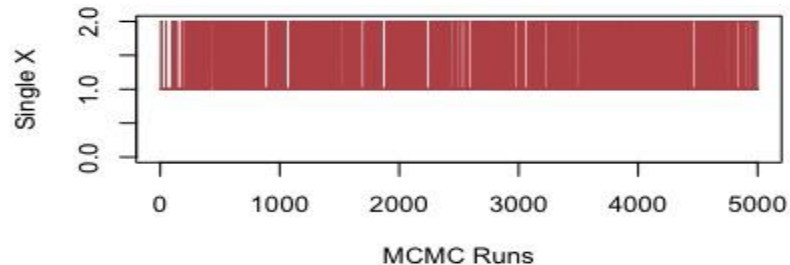
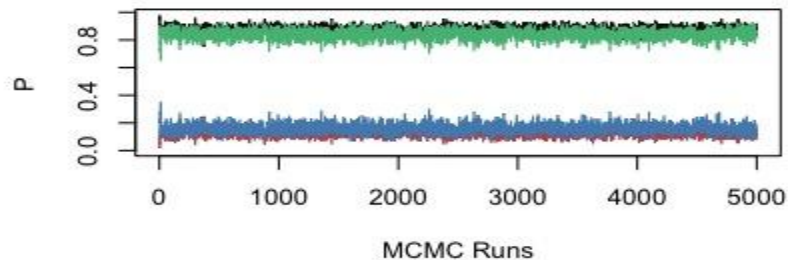
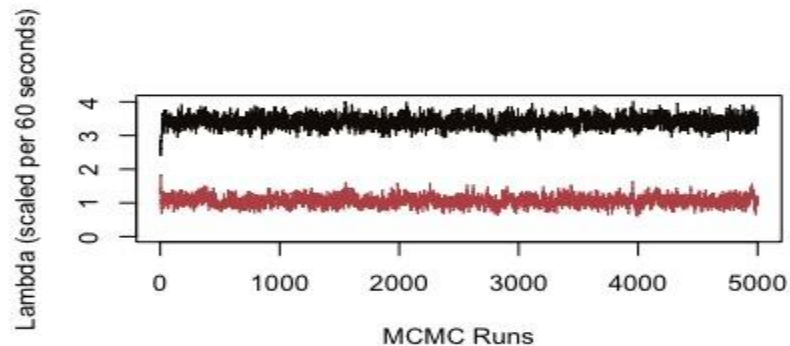


Predicted Trophallaxis Rates - High Density, 4 Hours

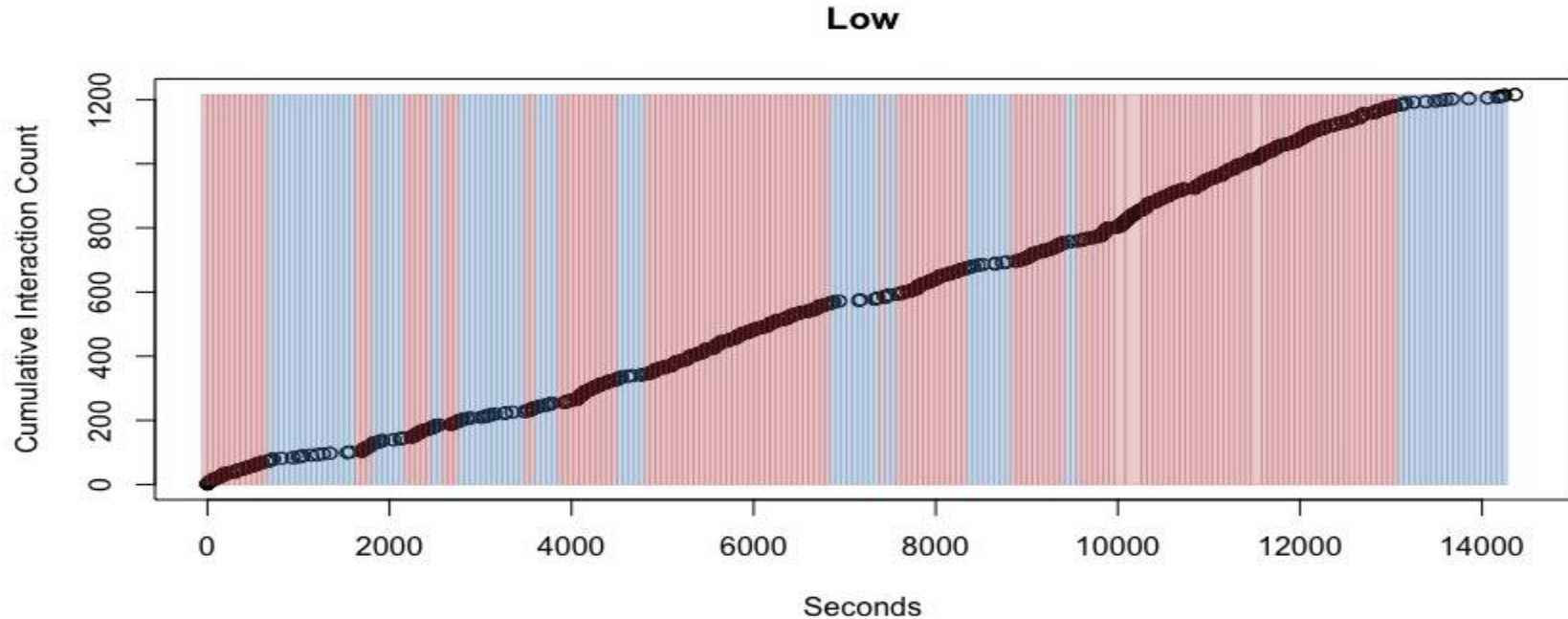


MCMC - Low Density, 4 Hours

Low Density, 4 Hours

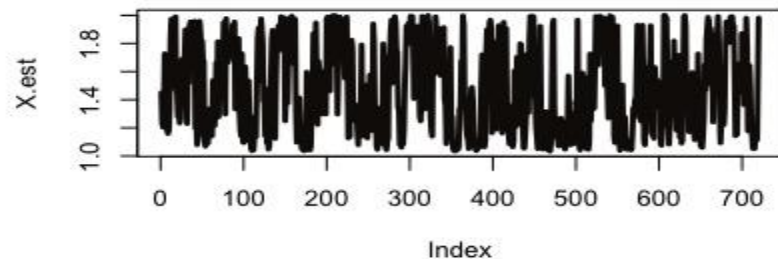
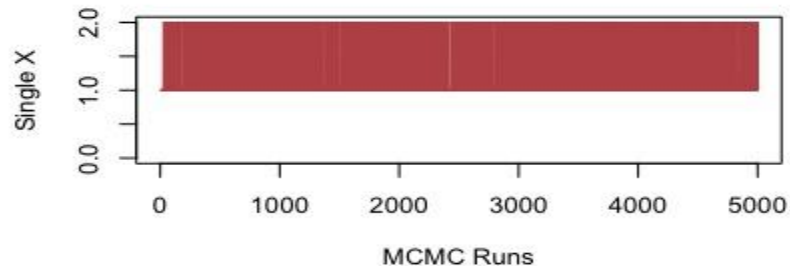
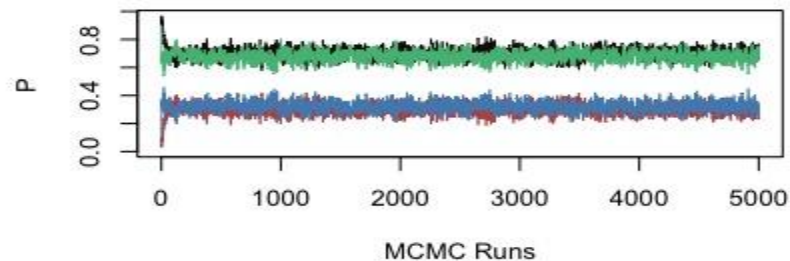
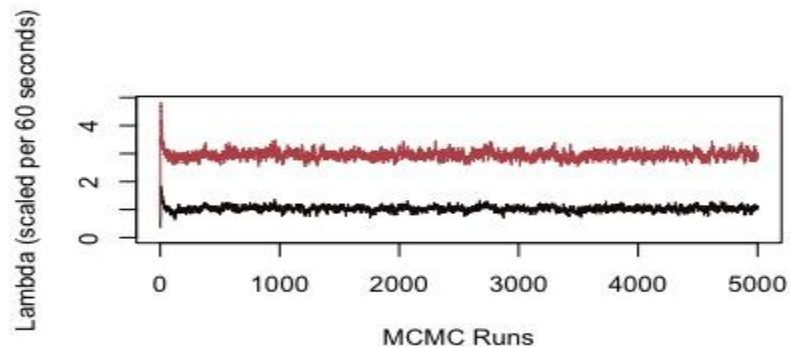


Predicted Trophallaxis Rates - Low Density, 4 Hours

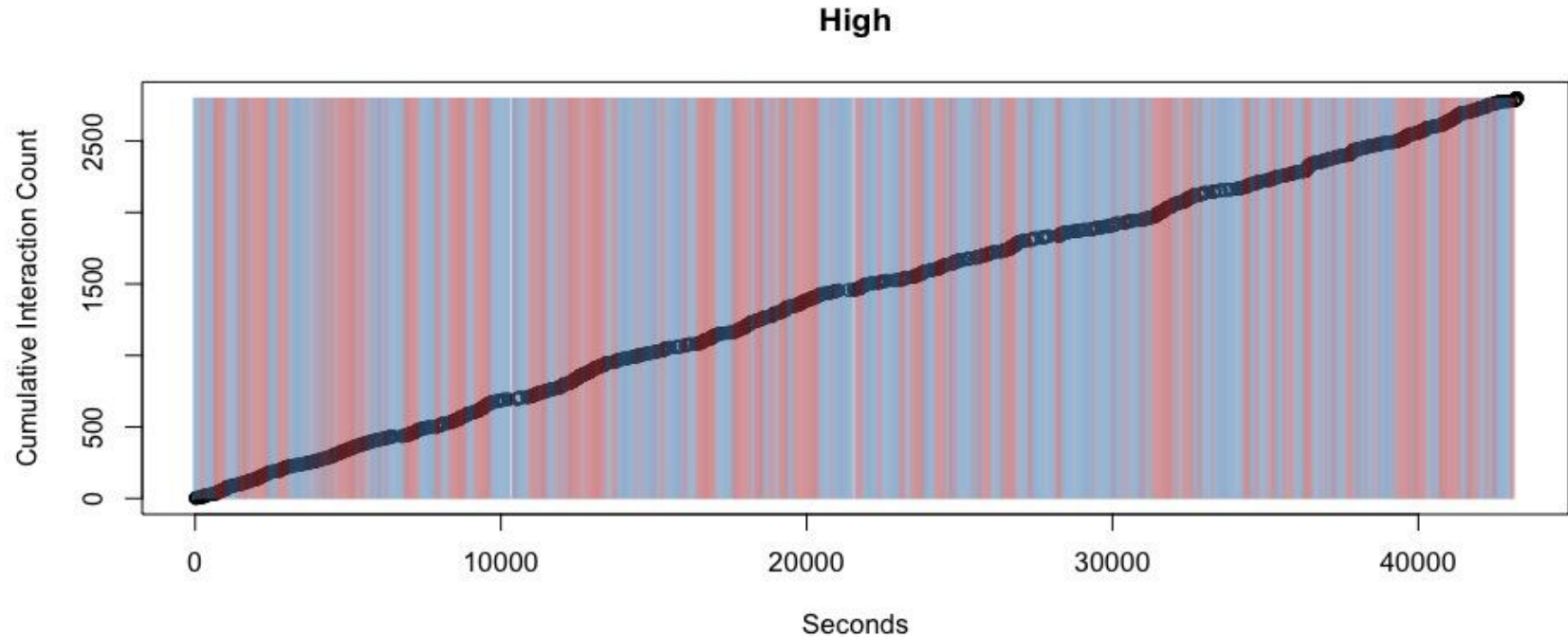


MCMC - High Density, 12 Hours

High Density, 12 Hours



Predicted Trophallaxis Rates - High Density, 12 Hours



Hidden Markov Model with Covariates

Observed Interactions, Entrances Times: $N_t \sim \text{Pois}(\lambda_{X_t}), W_t$

Unobserved States: $X_t | X_{t-1} \sim \text{Multinom}(1, p_{X_{t-1}}(\alpha, \beta))$

$$\lambda_{X_t} \sim \text{Gamma}(a, b)$$

$$P_{1,2}^t = e^{\beta_{-0} + \beta_{-1} * w_{-t}} / (1 + e^{\beta_{-0} + \beta_{-1} * W_{-t}})$$

$$P_{1,1}^t = 1 - P_{1,2}^t$$

$$P_{2,1}^t = e^{\alpha} / (1 + e^{\alpha})$$

$$P_{2,2}^t = 1 - P_{2,1}^t$$