Project

Due October 23

1. Consider the SIR model

$$
\begin{aligned}
\frac{dS}{dt} &= \delta N - \delta S - \gamma k I S \quad , \quad S(0) = 900, \\
\frac{dI}{dt} &= \gamma k I S - (r + \delta) I \quad , \quad I(0) = 100, \\
\frac{dR}{dt} &= rI - \delta R \quad , \quad R(0) = 0
\end{aligned}
$$

with the non-identifiable parameter set $q = [\gamma, r, \delta, k]$. Consider the file `SIR.txt`, which contains times t_j in the first column and corresponding values $I(t_j)$ in the second. Run DRAM and plot the pairwise distributions. Are your chains converging? Now modify the code to run the 3 parameter case

$$
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\frac{dI}{dt} &= \gamma I S - (r + \delta) I \quad , \quad I(0) = 100, \\
\frac{dR}{dt} &= rI - \delta R \quad , \quad R(0) = 0
\end{aligned}
$$

and discuss your results. Using the DRAM commands `mcmcpred` and `mcmcpredplot`, construct 95% credible and prediction intervals for each of the states. We will further discuss these results in the lecture on uncertainty propagation.

2. Consider the Helmholtz energy

$$
\psi(P, q) = \alpha_1 P^2 + \alpha_{11} P^4 + \alpha_{111} P^6,
$$

where P is the polarization on the interval $[0, 0.8]$ and $q = [\alpha_1, \alpha_{11}, \alpha_{111}]$ are parameters.

Using the data in the file `Helmholtz.txt`, which contains polarization values P_j in the first column and energies $\psi(P_j)$ in the second, employ DRAM to compute chains, marginal densities, and pairwise plots for the parameters. Note that you can employ the R Delayed Rejection algorithm if you would prefer.