Homework 5: working with Stan

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Stan is a probabilistic programming language that can be used to estimate the parameters that generated observed data. To see this, you will use Stan to estimate the parameters you chose in generating the data for Homework 4 using the Stochastic Simulation Algorithm (SSA).

Note that, for this homework, you will need to install the corresponding Stan library, depending on the language you use (RStan for R, PyStan for Python, etc.). Check the Stan website under "interfaces" for details.

1 Required

1. Write a Stan script that will estimate the model parameters from the SSA section of homework 4.
2. Write a script (R, Python, MATLAB, etc.) that loads the data from the SSA (either stored or simulated within the script), sets up the relevant dictionaries and calls the stan function. For this, we provide skeleton scripts (for R and Python), in case you don't want to write your own.

Then, run the estimation for various values of α and μ. How accurate is the estimation when $\alpha/\mu \simeq 1$? What about $\alpha/\mu \gg 1$ or $\alpha/\mu \ll 1$?

- Hint 1: check out https://github.com/kgourgou/set-phasers-to-stan/tree/homework and look at `8schools` and `regression-example` for examples of how to write Stan and R scripts.
- Hint 2: in the `homework` folder of the github page, you will find skeleton scripts for Stan, R, and Python.
- Hint 3: if you were unable to generate the data for homework 4, email "slauer" at "schoolph.umass.edu" and we will send you the script to do so.

2 Optional

1. Write a .stan file and a script that will estimate the model parameters from the Chemical Langevin Equation section of homework 4.

2. Write a Stan and API script that will estimate the model parameters from the Reaction Rate Equations of homework 4.

We have not done these yet - you're on your own! ODEs are formulated differently than the models in our examples and for the other parts of this homework. It may help to study the "Solving Differential Equations" section of the Stan manual (p.191, this can also befound on the github page).