Stochastic modelling of licensed stem cell states

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Here we explore the stochastic dynamics of the SP model previously discussed. The SP model captures the stochastic dynamics of a stem cell population composed of unlicensed (S species) and licensed (P species) states. The SP model is defined by the set of reactions

$$\begin{aligned} S &\xrightarrow{k_1} 2S \\ S &\underset{k_3}{\overset{k_2}{\rightleftharpoons}} P \\ 2P &\xrightarrow{k_4} \emptyset. \end{aligned} \tag{1}$$

You can download the files from
https://github.com/RodrigoGarciaTejera/EastBioClass/tree/main/Stochastic. The file run_SP_model.m runs a stochastic simulation and shows the trajectories as well as the histograms for the statistics of the S and P species.

Play with the parameters and see what outcomes you get. Note that lines 27 and 28 set the homeostatic number of S and P cells, and then k_3 and k_4 are set such that the system yields that homeostatic state.

Questions

- change the value of the S-to-P switching rate k_2, what happens when you increase it?
- try setting k_2 very slightly lower than k_1, what do you observe? what could the reason be?
- what happens if we remove the reversible reaction? For example, you can add a "%" symbol at the beginning of line 32 to comment it, and define k3=0 below.

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