

# Gillespie affinities and forces

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You have a vector of populations  $\mathbf{n}$ . This is instantaneous and varies over time stochastically.

The instantaneous propensities depend on the rates and stoichiometry. For a general reaction like

$$\sum_{i=1}^N \nu_i S_i \xrightleftharpoons[k^-]{k^+} \sum_{i=1}^N \nu'_i S_i \quad (1)$$

Where  $S_i$  is the names of species  $i$  and  $\nu_i$  is the stoichioetry.

You then have that the **forward propensities** are

$$a^+(\mathbf{n}) = k^+ \prod_{i=1}^N \binom{n_i}{\nu_i} \quad (2)$$

and similarly the **backward propensites** are

$$a^-(\mathbf{n}) = k^- \prod_{i=1}^N \binom{n_i}{\nu'_i} \quad (3)$$

You can then get an **instantaneous force** as

$$f_i = \ln(a^+/a^-) \quad (4)$$

And can average over time as usual.