https://en.wikipedia.org/wiki/Bernoulli_distribution

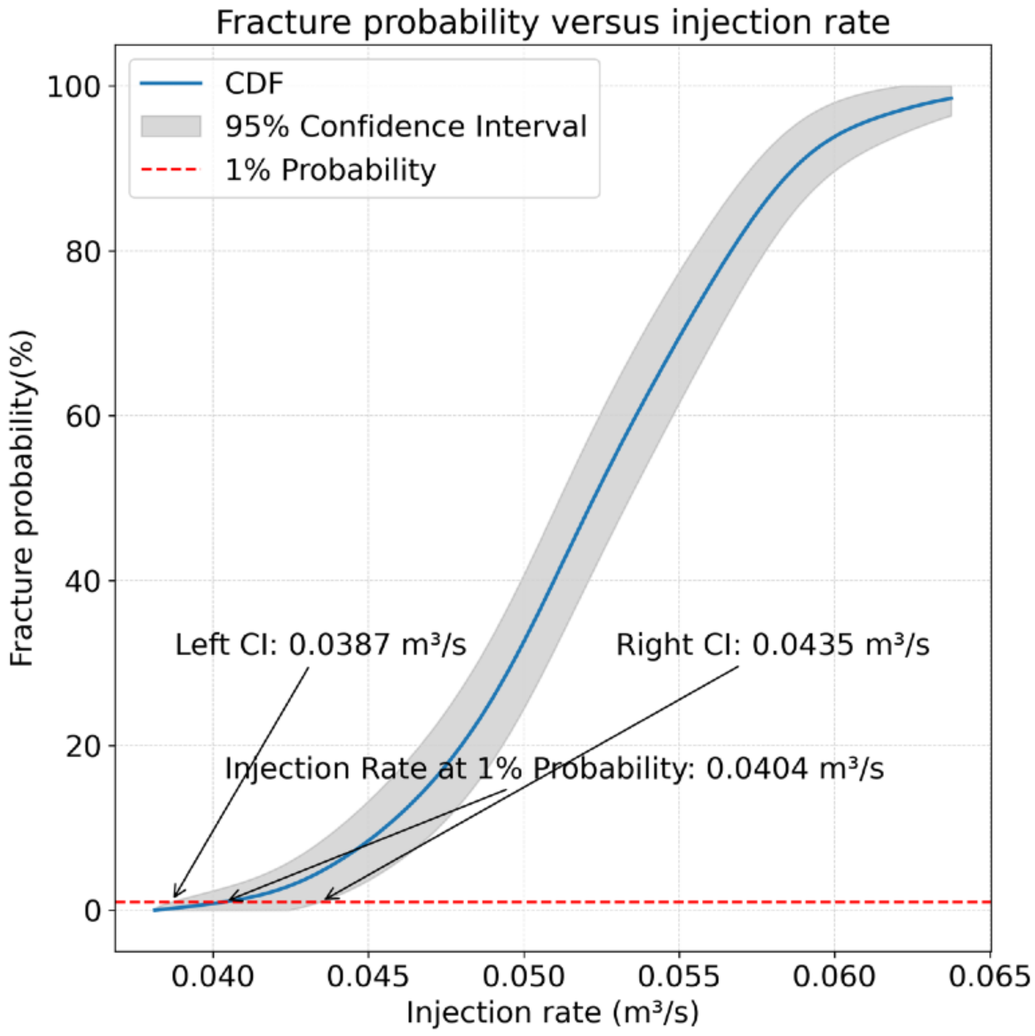
Injection rate
under uncertainty

Integrate the KDE to obtain cumulative distribution function

Assumption: non-fracture/fracture follows *Bernoulli* distribution (“toss a coin”)

For injection rate q_3:

- MLE of fracture probability $\hat{p}(q_3) = \mathrm{CDF}(q_3)$
- confidence interval $= \hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{N}}$
- for 95% ($\alpha = 0.05$) confidence interval, $Z_{\frac{\alpha}{2}} = 1.96$



q_3

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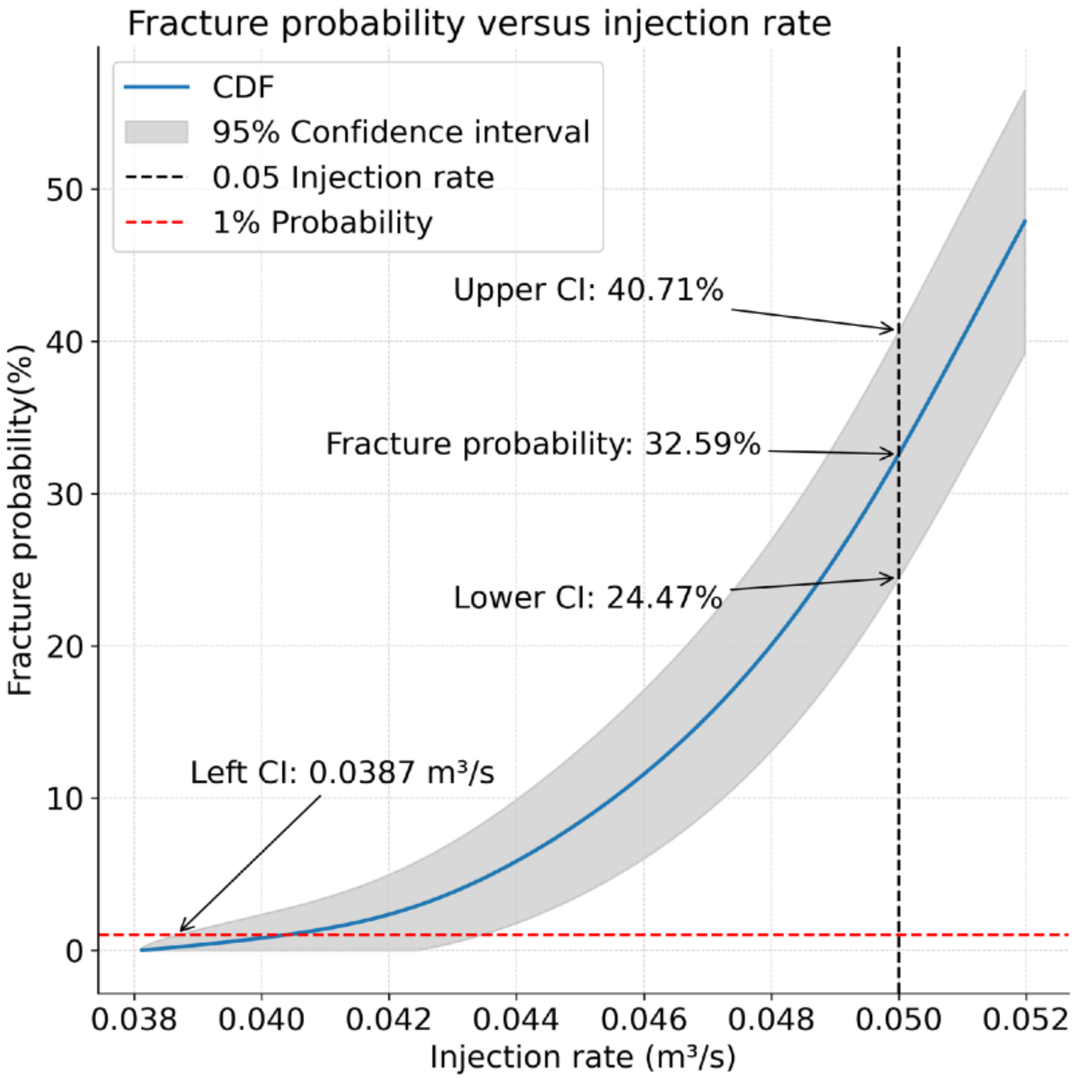
Control benefit

Given the *fracture probability*, DT allows us to choose *injection rate* with a certain *confidence interval* —e.g.,

- 97.5% confidence (left-CI)
- $q_3 = 0.0387\mathrm{m}^3/\mathrm{s}$
- fracture probability $< 1\,\%$

For the manually chosen injection rate $q_3 = 0.05m^3/s$,

- MLE of fracture probability $\mathrm{CDF}(q_3) = 32.59\,\%$
- we have 95% confidence that fracture probability is within 24.47 – 40.71%



q_3