1. Condition evidence

condition features x(t)

Fitted Student-t likelihood

state evidence p(x(t)|s)

- health
- local rate
- electrical load proxy
- spectral / structural shift
- efficiency

2. Hidden degradation states

fixed reference; four-state chain

Ref. → S_1 → S_2 → S_3 → S_4

Fixed · Stable · Drift · Risk · Collapse

$G = \{S_3, S_4\}$

Soft state-age inference

Joint state and residence-age probabilities

3. Residence evidence

Stress-dependent durations; posterior-weighted evidence

stress-dependent residence clock

residence evidence

completed / right censored

4. First passage

first entry time τ_G

closed risk set G

S_3 Risk → S_4 Collapse

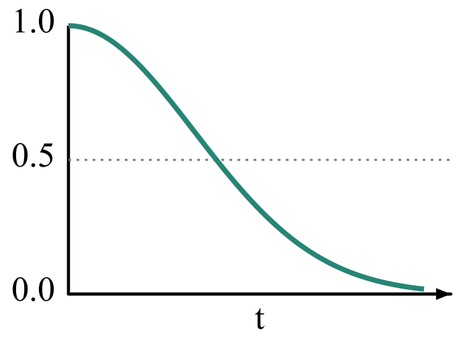
First entry into G defines reliability

τ_G

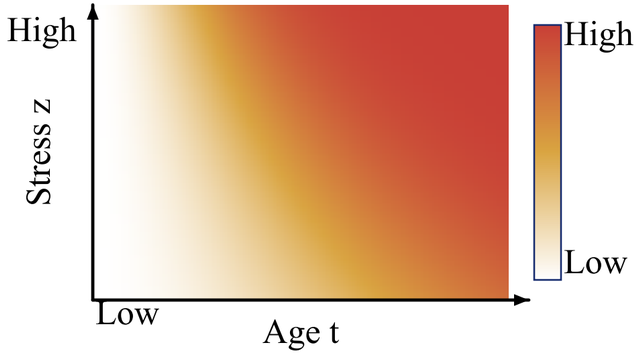
No return from the risk set

Reliability outputs

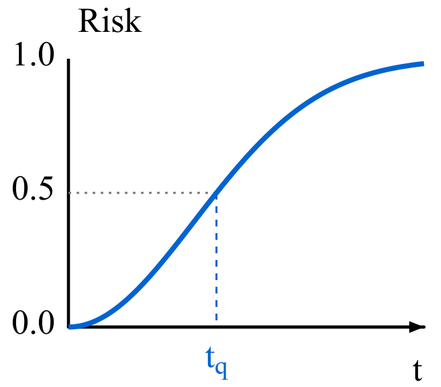
Survival $R_q(t|z)$



Age-stress risk surface $F_q(t, z)$



Cumulative risk $P(\tau_G \le t)$



Condition-updated RUL

