

Initial
latent
state:

$$\underbrace{\begin{bmatrix} \text{eta1} \\ \text{eta2} \end{bmatrix}}_{\boldsymbol{\eta}(t_0)}(t_0) \sim \text{N} \left(\underbrace{\begin{bmatrix} \text{T0m_eta1} \\ \text{T0m_eta2} \end{bmatrix}}_{\text{T0MEANS}}, \underbrace{UcorSDtoCov \left\{ \begin{bmatrix} \text{T0var_eta1} & 0 \\ \text{T0var_eta2_eta1} & \text{T0var_eta2} \end{bmatrix} \right\}}_{\underbrace{\mathbf{Q}^*_{t0}}_{\text{T0VAR}}} \right)$$

Deterministic
change:

$$\text{d} \underbrace{\begin{bmatrix} \text{eta1} \\ \text{eta2} \end{bmatrix}}_{\text{d}\boldsymbol{\eta}(t)}(t) = \left(\underbrace{\begin{bmatrix} -1 & 0 \\ 0.5 & -1 \end{bmatrix}}_{\underbrace{\mathbf{A}}_{\text{DRIFT}}} \underbrace{\begin{bmatrix} \text{eta1} \\ \text{eta2} \end{bmatrix}}_{\boldsymbol{\eta}(t)}(t) + \underbrace{\begin{bmatrix} 0 \\ 0 \end{bmatrix}}_{\underbrace{\mathbf{b}}_{\text{CINT}}} \right) \text{d}t +$$

Random
change:

$$\underbrace{UcorSDtoChol \left\{ \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right\}}_{\underbrace{\mathbf{G}}_{\text{DIFFUSION}}} \text{d} \underbrace{\begin{bmatrix} W_1 \\ W_2 \end{bmatrix}}_{\text{d}\mathbf{W}(t)}(t)$$

Observations:

$$\underbrace{\begin{bmatrix} \text{Y1} \\ \text{Y2} \end{bmatrix}}_{\mathbf{Y}(t)}(t) = \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}}_{\underbrace{\mathbf{\Lambda}}_{\text{LAMBDA}}} \underbrace{\begin{bmatrix} \text{eta1} \\ \text{eta2} \end{bmatrix}}_{\boldsymbol{\eta}(t)}(t) + \underbrace{\begin{bmatrix} \text{mm_Y1} \\ \text{mm_Y2} \end{bmatrix}}_{\underbrace{\boldsymbol{\tau}}_{\text{MANIFESTMEANS}}} +$$

Observation
noise:

$$\underbrace{\begin{bmatrix} \text{mvarY1} & 0 \\ 0 & \text{mvarY2} \end{bmatrix}}_{\underbrace{\boldsymbol{\Theta}}_{\text{MANIFESTVAR}}} \underbrace{\begin{bmatrix} \epsilon_1 \\ \epsilon_2 \end{bmatrix}}_{\boldsymbol{\epsilon}(t)}(t)$$

System noise
distribution per time
step: $\Delta[W_{j \in [1,2]}](t-u) \sim \text{N}(0, t-u)$

Observation noise
distribution: $[\epsilon_{j \in [1,2]}](t) \sim \text{N}(0, 1)$

Note: *UcorSDtoChol* converts lower tri matrix of standard deviations and unconstrained correlations to Cholesky factor, *UcorSDtoCov* = transposed cross product of *UcorSDtoChol*, to give covariance, See Driver & Voelkle (2018) p11.