

$$\text{Subject parameter distribution: } \underbrace{\begin{bmatrix} \text{muT1}_i \\ \text{muT2}_i \\ \text{muT3}_i \\ \text{muT4}_i \\ \text{beta33}_i \\ \text{beta43}_i \\ \text{beta34}_i \\ \text{beta44}_i \\ \text{cint1}_i \\ \text{cint2}_i \\ \text{cint3}_i \\ \text{cint4}_i \end{bmatrix}}_{\phi(i)} \sim \text{tform} \left\{ \text{N} \left(\underbrace{\begin{bmatrix} \text{raw_muT1} \\ \text{raw_muT2} \\ \text{raw_muT3} \\ \text{raw_muT4} \\ \text{raw_beta33} \\ \text{raw_beta43} \\ \text{raw_beta34} \\ \text{raw_beta44} \\ \text{raw_cint1} \\ \text{raw_cint2} \\ \text{raw_cint3} \\ \text{raw_cint4} \end{bmatrix}}_{\text{TOMEANS}}, \underbrace{\begin{bmatrix} \text{rawPCov_2.1} & \text{rawPCov_2.2} & \text{rawPCov_3.2} & \text{rawPCov_4.2} & \text{rawPCov_5.2} & \text{rawPCov_6.2} & \text{rawPCov_7.2} & \text{rawPCov_8.2} & \text{rawPCov_9.2} & \text{rawPCov_10.2} & \text{rawPCov_11.2} & \text{rawPCov_12.2} \\ \text{rawPCov_3.1} & \text{rawPCov_3.2} & \text{rawPCov_3.3} & \text{rawPCov_4.3} & \text{rawPCov_5.3} & \text{rawPCov_6.3} & \text{rawPCov_7.3} & \text{rawPCov_8.3} & \text{rawPCov_9.3} & \text{rawPCov_10.3} & \text{rawPCov_11.3} & \text{rawPCov_12.3} \\ \text{rawPCov_4.1} & \text{rawPCov_4.2} & \text{rawPCov_4.3} & \text{rawPCov_4.4} & \text{rawPCov_5.4} & \text{rawPCov_6.4} & \text{rawPCov_7.4} & \text{rawPCov_8.4} & \text{rawPCov_9.4} & \text{rawPCov_10.4} & \text{rawPCov_11.4} & \text{rawPCov_12.4} \\ \text{rawPCov_5.1} & \text{rawPCov_5.2} & \text{rawPCov_5.3} & \text{rawPCov_5.4} & \text{rawPCov_5.5} & \text{rawPCov_6.5} & \text{rawPCov_7.5} & \text{rawPCov_8.5} & \text{rawPCov_9.5} & \text{rawPCov_10.5} & \text{rawPCov_11.5} & \text{rawPCov_12.5} \\ \text{rawPCov_6.1} & \text{rawPCov_6.2} & \text{rawPCov_6.3} & \text{rawPCov_6.4} & \text{rawPCov_6.5} & \text{rawPCov_6.6} & \text{rawPCov_7.6} & \text{rawPCov_8.6} & \text{rawPCov_9.6} & \text{rawPCov_10.6} & \text{rawPCov_11.6} & \text{rawPCov_12.6} \\ \text{rawPCov_7.1} & \text{rawPCov_7.2} & \text{rawPCov_7.3} & \text{rawPCov_7.4} & \text{rawPCov_7.5} & \text{rawPCov_7.6} & \text{rawPCov_7.7} & \text{rawPCov_8.7} & \text{rawPCov_9.7} & \text{rawPCov_10.7} & \text{rawPCov_11.7} & \text{rawPCov_12.7} \\ \text{rawPCov_8.1} & \text{rawPCov_8.2} & \text{rawPCov_8.3} & \text{rawPCov_8.4} & \text{rawPCov_8.5} & \text{rawPCov_8.6} & \text{rawPCov_8.7} & \text{rawPCov_8.8} & \text{rawPCov_9.8} & \text{rawPCov_10.8} & \text{rawPCov_11.8} & \text{rawPCov_12.8} \\ \text{rawPCov_9.1} & \text{rawPCov_9.2} & \text{rawPCov_9.3} & \text{rawPCov_9.4} & \text{rawPCov_9.5} & \text{rawPCov_9.6} & \text{rawPCov_9.7} & \text{rawPCov_9.8} & \text{rawPCov_9.9} & \text{rawPCov_10.9} & \text{rawPCov_11.9} & \text{rawPCov_12.9} \\ \text{rawPCov_10.1} & \text{rawPCov_10.2} & \text{rawPCov_10.3} & \text{rawPCov_10.4} & \text{rawPCov_10.5} & \text{rawPCov_10.6} & \text{rawPCov_10.7} & \text{rawPCov_10.8} & \text{rawPCov_10.9} & \text{rawPCov_10.10} & \text{rawPCov_11.10} & \text{rawPCov_12.10} \\ \text{rawPCov_11.1} & \text{rawPCov_11.2} & \text{rawPCov_11.3} & \text{rawPCov_11.4} & \text{rawPCov_11.5} & \text{rawPCov_11.6} & \text{rawPCov_11.7} & \text{rawPCov_11.8} & \text{rawPCov_11.9} & \text{rawPCov_11.10} & \text{rawPCov_11.11} & \text{rawPCov_12.11} \\ \text{rawPCov_12.1} & \text{rawPCov_12.2} & \text{rawPCov_12.3} & \text{rawPCov_12.4} & \text{rawPCov_12.5} & \text{rawPCov_12.6} & \text{rawPCov_12.7} & \text{rawPCov_12.8} & \text{rawPCov_12.9} & \text{rawPCov_12.10} & \text{rawPCov_12.11} & \text{rawPCov_12.12} \end{bmatrix}}_{\text{TOVAR}} \right\}$$

$$\text{Initial latent state: } \underbrace{\begin{bmatrix} \text{T1_sym} \\ \text{T2_sym} \\ \text{T3_psb} \\ \text{T4_psb} \\ \text{dyn_sym} \\ \text{dyn_psb} \end{bmatrix}}_{\eta(t_0)} (t_0) \sim \text{N} \left(\underbrace{\begin{bmatrix} \text{muT1} \\ \text{muT2} \\ \text{muT3} \\ \text{muT4} \\ 0 \\ 0 \end{bmatrix}}_{\text{TOMEANS}}, \underbrace{UcorSDtoCov \left\{ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \text{varO3} & 0 \\ 0 & 0 & 0 & 0 & \text{corZ43} & \text{varO4} \end{bmatrix} \right\}}_{\mathbf{Q}^*_{t0 \text{ TOVAR}}} \right)$$

$$\text{Deterministic change: } \text{d} \underbrace{\begin{bmatrix} \text{T1_sym} \\ \text{T2_sym} \\ \text{T3_psb} \\ \text{T4_psb} \\ \text{dyn_sym} \\ \text{dyn_psb} \end{bmatrix}}_{\text{d}\eta(t)} (t) = \underbrace{\begin{bmatrix} \text{drift1} & 0 & 0 & 0 & 0 & 0 \\ 0 & \text{drift2} & 0 & 0 & 0 & 0 \\ 0 & 0 & \text{drift3} & 0 & 0 & 0 \\ 0 & 0 & 0 & \text{drift4} & 0 & 0 \\ 0 & 0 & 0 & 0 & \text{beta33} & \text{beta43} \\ 0 & 0 & 0 & 0 & \text{beta34} & \text{beta44} \end{bmatrix}}_{\mathbf{A}_{\text{DRIFT}}} \underbrace{\begin{bmatrix} \text{T1_sym} \\ \text{T2_sym} \\ \text{T3_psb} \\ \text{T4_psb} \\ \text{dyn_sym} \\ \text{dyn_psb} \end{bmatrix}}_{\eta(t)} (t) + \underbrace{\begin{bmatrix} \text{cint1} \\ \text{cint2} \\ \text{cint3} \\ \text{cint4} \\ 0 \\ 0 \end{bmatrix}}_{\mathbf{b}_{\text{CINT}}} \text{dt} +$$

$$\text{Random change: } \underbrace{UcorSDtoChol \left\{ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \text{varZ33} & 0 \\ 0 & 0 & 0 & 0 & \text{corZ43} & \text{varZ44} \end{bmatrix} \right\}}_{\mathbf{G}_{\text{DIFFUSION}}} \text{d} \underbrace{\begin{bmatrix} W_1 \\ W_2 \\ W_3 \\ W_4 \\ W_5 \\ W_6 \end{bmatrix}}_{\text{d}\mathbf{W}(t)} (t)$$

$$\text{Observations: } \underbrace{\begin{bmatrix} \text{symA} \\ \text{symB} \\ \text{psbA} \\ \text{psbB} \end{bmatrix}}_{\mathbf{Y}(t)} (t) = \underbrace{\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & \text{lam1} & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 & \text{lam2} \end{bmatrix}}_{\mathbf{\Lambda}_{\text{LAMBDA}}} \underbrace{\begin{bmatrix} \text{T1_sym} \\ \text{T2_sym} \\ \text{T3_psb} \\ \text{T4_psb} \\ \text{dyn_sym} \\ \text{dyn_psb} \end{bmatrix}}_{\eta(t)} (t) + \underbrace{\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}}_{\tau_{\text{MANIFESTMEANS}}} +$$

$$\text{Observation noise: } \underbrace{\begin{bmatrix} \text{E_symA} & 0 & 0 & 0 \\ 0 & \text{E_symB} & 0 & 0 \\ 0 & 0 & \text{E_psbA} & 0 \\ 0 & 0 & 0 & \text{E_pspB} \end{bmatrix}}_{\mathbf{\Theta}_{\text{MANIFESTVAR}}} \underbrace{\begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ \epsilon_4 \end{bmatrix}}_{\epsilon(t)} (t)$$

System noise distribution per time step: $\Delta[W_{j \in [1,6]}](t-u) \sim \text{N}(0, t-u)$ Observation noise distribution: $[\epsilon_{j \in [1,6]}](t) \sim \text{N}(0, 1)$

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. Individual specific notation (subscript i) only shown for subject parameter distribution – pop. means shown elsewhere.