
Appendix for "Modeling multiple event streams with latent semi-Markov processes"

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1. Graphical model

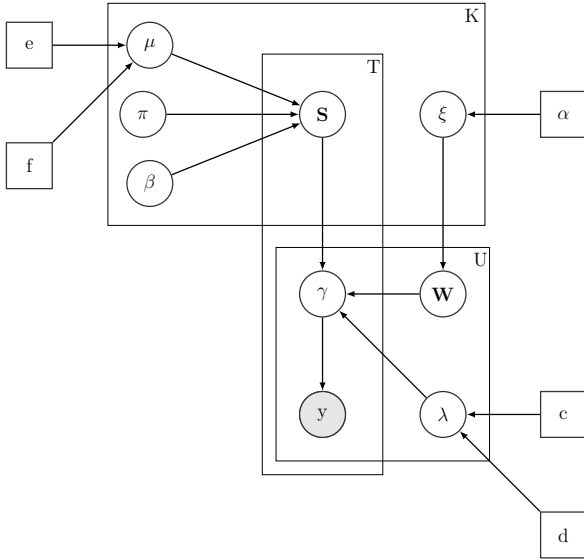


Figure 1. The graphical representation of the proposed model

2. Generative process for bsMJP

Algorithm 1 Generative process for a K -dimensional bsMJP path in $[0, T]$

Input: Hazard function of each state and each latent feature $h_{0k}(\cdot), h_{1k}(\cdot), k = 1, \dots, K$, constant hazard rates Ω_{0k}, Ω_{1k} , and initial state distribution π_0 .

Output: A K -dimensional sMJP path $\{\phi_k, \mathbf{s}_k(\phi_k)\}$

- 1: **while** $k \in \{1, 2, \dots, K\}$ **do**
 - 2: Initialize $l_0 = 0, i = 0, \tilde{\phi}_{k,0} = 0, \phi_k = \{\tilde{\phi}_{k,0}\}, \tilde{\mathbf{s}}_k(\tilde{\phi}_{k,0}) \sim \pi_0$,
 - 3: **while** $\tilde{\phi}_{k,i} < T$ **do**
 - 4: increment i
 - 5: Sample $\Delta_i \sim H_{\tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i-1}),k}(\cdot)$. Set $\tilde{\phi}_{k,i} = \tilde{\phi}_{k,i-1} + \Delta_i$.
 - 6: Draw $\delta \sim \text{Unif}(0, 1)$
 - 7: **if** $\delta < \frac{h_{\tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i-1}),k}(l_{i-1} + \Delta_i)}{h_{\tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i-1}),k}(l_{i-1} + \Delta_i) + \Omega_{\tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i-1}),k}}$ **then**
 - 8: Set $l_i = 0, \tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i}) = 1 - \tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i-1}), \phi_k = \phi_k \cup \{\tilde{\phi}_{k,i}\}$
 - 9: **else**
 - 10: Set $l_i = l_{i-1} + \Delta_i, \tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i}) = \tilde{\mathbf{s}}_k(\tilde{\phi}_{k,i-1})$
 - 11: **end if**
 - 12: **end while**
 - 13: $\phi_k = \phi_k \cup \{T\}, \{\phi_k, \mathbf{s}_k = \tilde{\mathbf{s}}_k(t), t \in \phi_k\}$ is a generated bsMJP path.
 - 14: **end while**
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