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

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1. Graphical model

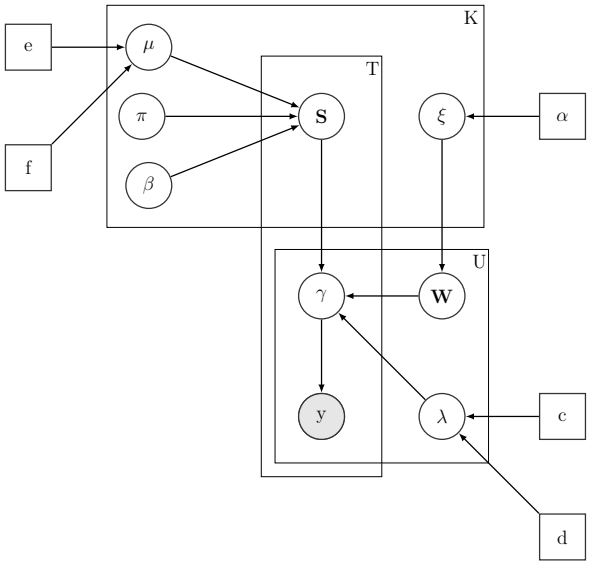

Figure 1. The graphical representation of the proposed model

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 $h_{0k}(\cdot), h_{1k}(\cdot), k = 1, \cdots, K$, constant hazard rates Ω_{0k}, Ω_{1k}, and initial state distribution π_0.
Output: A K-dimensional sMJP path $\{\phi_k, \boldsymbol{s}_k(\phi_k)\}$

while $k \in \{1, 2, \cdots, K\}$ **do**
  Initialize $l_0 = 0, i = 0, \tilde{\phi}_{k,0} = 0$, $\phi_k = \{\tilde{\phi}_{k,0}\}$, $\tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,0}) \sim \pi_0$,
  while $\tilde{\phi}_{k,i} < T$ **do**
    increment i
    Sample $\Delta_i \sim H_{\tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i-1}),k}(\cdot)$. Set $\tilde{\phi}_{k,i} = \tilde{\phi}_{k,i-1} + \Delta_i$.
    Draw $\delta \sim \text{Unif}(0, 1)$
    if $\delta < \frac{h_{\tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i-1}),k}(l_{i-1}+\Delta_i)}{h_{\tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i-1}),k}(l_{i-1}+\Delta_i)+\Omega_{\tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i-1}),k}}$ **then**
      Set $l_i = 0, \tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i}) = 1 - \tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i-1}), \phi_k = \phi_k \cup \{\tilde{\phi}_{k,i}\}$
    else
      Set $l_i = l_{i-1} + \Delta_{i+1}, \tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i}) = \tilde{\boldsymbol{s}}_k(\tilde{\phi}_{k,i-1})$
    end if
  end while
  $\phi_k = \phi_k \cup \{T\}$, $\{\phi_k, \boldsymbol{s}_k = \tilde{\boldsymbol{s}}_k(t), t \in \phi_k\}$ is a generated bsMJP path.
end while