Bayesian Learning and Inference in Recurrent Switching Linear Dynamical Systems

Charbel Abi Younes, Marvyn Bailly,
Bart Boom, Rohin Gilman, Daran Xu

April 27, 2023

UNIVERSITY *of* WASHINGTON | Applied Mathematics

Table of Contents

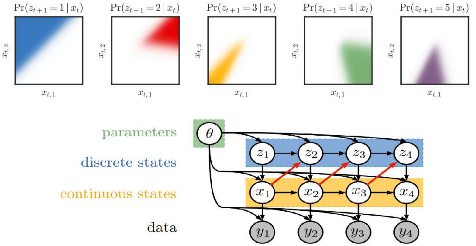
Frame Title
Frame Subtitle

Rohin

Model
SLDS and rSLDS

Model Set-up

- Observation $y_t = Cx_t + d + w_t,\ w_t \overset{\text{iid}}{\sim} \mathcal{N}(0, S)$
- Continous latent state $x_{t+1} = A_{z_{t+1}} x_t + b_{z_{t+1}} + \nu_t,\ \nu_t \overset{\text{iid}}{\sim} \mathcal{N}(0, Q_{z_{t+1}})$
- Discrete latent state $z_t \in \{1, \ldots, K\}$
  - SLDS $z_{t+1} | z_t \sim \pi_{z_t}$
  - rSLDS $z_{t+1} | z_t, x_t \sim \pi_{SB}(\nu_{t+1}),\ \nu_{t+1} = R_{z_t} x_t + r_{z_t}$



rSLDS

Model
Stick Breaking Logitstic Regression

???????

- $p(z|x) \sim \pi_{SB}(\nu),\ \nu = Rx + r$
- Link function: $\pi_{SB}(\nu) = \left(\pi_{SB}^{(1)}(\nu), \ldots, \pi_{SB}^{(K)}(\nu)\right)$

  $\pi_{SB}^{(k)}(\nu) =$
  $$\begin{cases} \sigma(\nu_k) \prod_{j<k} (1 - \sigma(\nu_j)) = \sigma(\nu_k) \prod_{j<k} \sigma(-\nu_j), & \text{if } k = 1, \ldots, K-1 \\ \prod_1^K \sigma(-\nu_j), & \text{if} k = K \end{cases}$$
  $\sigma(x) = \frac{e^x}{1+e^x}$
- $p(z|x) \sim \prod_{k=1}^K \sigma(\nu_k)^{\mathbb{1}[z=k]} \sigma(-\nu_k)^{\mathbb{1}[z>k]}$ (Likelihood),
- Prior $p(x) \sim \mathcal{N}$
- Posterior $p(x|z)$ is non-Gaussian
  - need to do MCMC
  -

Daran

Frame Title
Frame Subtitle

Rohin

Frame Title
Frame Subtitle

Rohin

Frame Title
Frame Subtitle

This is a frame with a title and a subtitle.

This is a frame with no title.

This is a frame with no header.

Text

<ins>This is underlined text.</ins>

This is italic text.

This is bold text.

`This is mono-spaced text.`

Lists

This is a bulleted list:

- An item
- Another item
    - A subitem
    - Another subitem

This is a numbered list:

1. An item
2. Another item
    2.1 A subitem
    2.2 Another subitem

Colored Blocks

Block Title

This is a block.

Alert Block Title

This is an alertblock.

Example

This is an example block.

Frame Title

This is a frame the second section.

Frame Title

This is a frame with a...

Frame Title

This is a frame with a...

\pause.

Bibliography

Albert Einstein.

Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies].

Annalen der Physik, 322(10):891–921, 1905.

Michel Goossens, Frank Mittelbach, and Alexander Samarin.

The LaTeX Companion.

Addison-Wesley, Reading, Massachusetts, 1993.

Donald Knuth.

Knuth: Computers and typesetting.