# Notations (common)

Each row is the recording for neuron , , Denote the cluster index for neuron as . The number of neurons in cluster is , and .

# Model

Denote the latent vector in cluster as . For simplicity, assume all . Each observation follows a Poisson distribution as follows:

Where and .

In this version, the loading and are also cluster dependent. That is,

Denote all latent states as and they evolve linearly with Gaussian noise:

To simplify, assume is known (e.g. ).

If we assume block diagonal (as in Joshua et al., 2020) for process noise covariance, we can write things as:

Notice forms the full transition matrix as:

If the row block of is . Then, .

If we further let be diagonal: denote the row of , , as , , . The corresponding process noise variance as . Then:

The parameters need to estimate:

1. Latent vectors:
2. Initials:
3. Linear mapping for latent vectors: and
4. Mean and covariance for linear mapping in each cluster: and
5. Linear dynamics for latent vectors: and
6. Process noise:

Since the progress noise is independent in the model, , where is the Poisson density and is the parameters in cluster .

# Conditional Priors

Others are the same as v3, but modify loading related ones, i.e. mean and covariance for linear mapping in each cluster and :

Where and

Where and

# MCMC iteration

Others are the same as v3, but modify loading related ones.

1. Update and :

Denote and .

Where is Poisson log-likelihood.

Use Newton-Raphson to find and

1. Update and :

Again, denote .

Mean : by conjugacy,

Covariance: by conjugacy,

When doing the clustering, there may be too few observation for covariance estimation…

Can we assume is the same for all clusters, or even fix it to be known?

If assume , then