# General Form

Since we are now interested in dispersion, we need our time bin be large enough to allow multiple spikes. And we also need independent observations. Denote the number of spikes at step in neuron be and all observations at step as

If we only allow be 1 or 0, then the distribution is forced to be Bernoulli or approximately Poisson because of small intervals.

Denote , and

Then the likelihood is:

, where

And the log-likelihood is:

Then follow the same rationale as (A.3) in Eden’s paper:

Take Log on both sides:

Differentiate once and twice with respect to :

<Some dimensions don’t match (be careful about transpose), fix later…>

Evaluating these 2 derivatives at yields:

OK, let’s deal with and .

Then, there are four pieces remaining to deal with:

Now, we further need to write , , , and explicitly.

OK, put them altogether…

To compare with version 1, we can write everything out:

This is equivalent to version 1

When and , then this is exactly as derived in Eden’s paper.

# In Context of Linear Regression

Let

Then , , and