Theoretical Neuroscience I Exercise 8: Maximum likelihood inference Cormac Collins, Paulina Gonzalez, Nicole D'Souza

I: Joint probability and conditional likelihood

Using prior knowledge on how likely four neurons were to respond to different stimuli, the aim here was to compute the marginal probability and conditional likelihood of responses of these four neurons and then identify the preferred stimulus of each neuron.

The four neurons were stimulated using values of 5-20 and the responses were observed. In figure 1, the conditional likelihood is plotted together with the corresponding stimuli and responses. According to the figure, the preferred stimuli for each neuron are as follows: Neuron 1, 5; Neuron 2, 10; Neuron 3, 15; Neuron 4, 20.

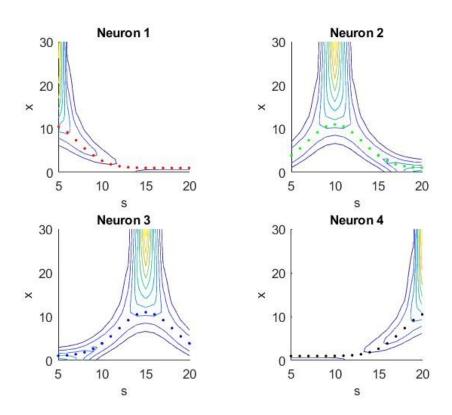


Figure 1: Conditional likelihood as a function of stimuli and given response for four neurons

II. Stimulus likelihood

The aim here was to compute the joint conditional log likelihoods of different stimuli having caused three different responses r_a , r_b , and r_c . These likelihoods of the responses were plotted as a function of the stimulus as shown in figure 2.

Figure 2 shows that the stimuli to likely have caused responses a, b, and c, are approximately 7, 16, and 19, respectively.

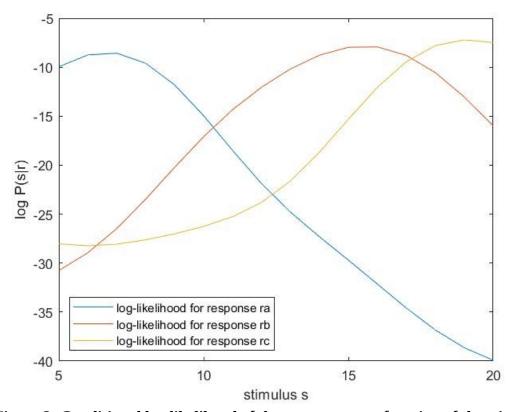


Figure 2: Conditional log likelihood of the responses as a function of the stimuli.

III. Stimulus decoding

For this assignment, 100 responses were generated for each stimulus value between 5 and 20, for each of the four neurons. Conditional log-likelihood was calculated. The stimuli that caused the highest conditional log likelihood-value, *SML* were determined for each of the 100 responses.

Thereafter, S_{ML} was averaged over all repetitions and was then plotted against the real stimulus s in figure 3; the standard deviation of the S_{ML} was plotted against the real stimulus, as seen in figure 4. The figures show that the activity for each stimulus varies. Hence, some stimuli are better encoded than the others.

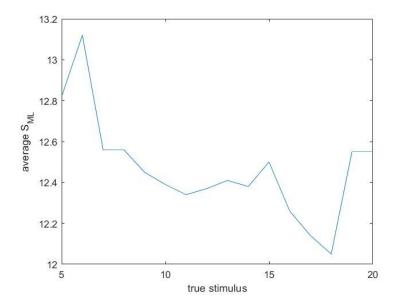


Figure 3: Average S_{ML} as a function of the real stimulus

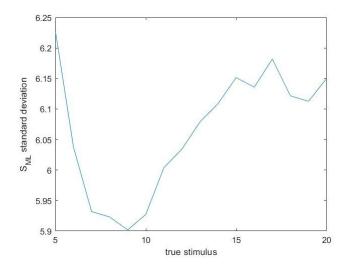


Figure 4: Standard deviation of the S_{ML} as a function of the real stimulus