

Appendix S2. Derivation of Eq. 9

We have a set of firing rates \mathbf{r} for the N neurons in each trial ($\mathbf{r} = [r_1, \dots, r_N]$). In the present model we assume that each neuron fires independently, and then the joint probability for the whole population is given by

$$P(\mathbf{r} | \alpha) = \prod_{i=1}^N P(r_i | \alpha).$$

The number of spikes for each neuron varies across trials. We assume that this variability is described by a Poisson process:

$$P(r_i | \alpha) = \frac{(\lambda_i T)^{r_i T}}{(r_i T)!} e^{-\lambda_i T},$$

where T is the length of time during which spikes are sampled (i.e., $r_i T$ spikes are sampled in total during the observation). Therefore, the log likelihood of the falloff parameter α is written as

$$\ln P(\mathbf{r} | \alpha) = T \left(r_i \ln \lambda_i(\alpha) - \lambda_i(\alpha) + r_i \ln T - \frac{\ln((r_i T)!)}{T} \right).$$