Homework 5.1: Poisson neuron

Interval distribution

1/1 point (graded)

We consider a neuron that fires stochastically. Its firing rate is described by a Poisson process of rate ρ. In other words, in every small time interval Δt, the probability that the neuron fires is given by $\rho \Delta t$.

Suppose that the neuron is driven by some input. For $t < t_0$, the input is weak, so that its firing rate is $\rho_0 = 2\ Hz$. For $t_0 < t < t_1 = t_0 + 100\ ms$, the input is strong and the neuron fires at $\rho_1 = 20\ Hz$.

What is the interval distributions $P(t)$ if the firing rate is ρ?

- $(1-\rho)\, e^{-\rho t}$
- $1 - e^{-\frac{t}{\rho}}$
- $\rho e^{-\frac{t}{\rho}}$
- $e^{-\rho t}$
- ✔ $\rho e^{-\rho t}$
- ρ
- $\frac{1}{\rho} e^{-\frac{t}{\rho}}$
- $1 - e^{-\rho t}$

✔

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✔ Correct (1/1 point)

Probability calculation 1

1/1 point (graded)

What is the probability to observe an interspike interval smaller than $20\ ms$?

- $(1-\rho)\, e^{-20\rho}$
- $1 - e^{-\frac{20}{\rho}}$
- $\rho e^{-\frac{20}{\rho}}$
- $e^{-20\rho}$
- $\rho e^{-20\rho}$

- ρ
- $\frac{1}{\rho}e^{-\frac{20}{\rho}}$
- $1-e^{-20\rho}$ ✔

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Probability calculation 2

1/1 point (graded)

Now calculate the probability of having a burst consisting of **two intervals** of less than $20\ ms$ each. We call these probabilities p_{weak} and p_{strong} if the input is weak, i.e., with firing rate $\rho_0 = 2\ Hz$ and if it is strong, i.e., with firing rate $\rho_1 = 20\ Hz$, respectively.

What is the ratio $\frac{p_{strong}}{p_{weak}}$, approximately?

- 1
- 2
- 8.5
- 10
- 46.2
- 60.5
- 70.7 ✔

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Discussion

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