9.073/HST.460 Statistics for Neuroscience Research
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Programming Note for Problem Set 3

The time-rescaling theorem states that given $0 \le t_1, t_2, \ldots, t_n \le T$ the spike times from a point process with a conditional intensity function $\lambda(t \mid H_t)$ then $z_j = \int_{t_{j-1}}^{t_j} \lambda(u \mid H_u) du$ are independent, observations from an exponential probability model with parameter $\lambda = 1.$ This theorem offers a way to assess agreement between a proposed model for the conditional intensity function and a given spike train data set. We evaluate whether the model $z_j s$ are exponential by using a KS Plot and its 95% confidence intervals. To make the KS plot, we transform the $z_j s$ to $u_j s$ using the formula $u_j = 1 - \exp(-z_j).$ The $u_j s$ are uniform on the interval (0,1). To assess whether the $u_j s$ are independent we make one additional transformation which is $x_j = \Phi^{-1}(u_j),$ where $\Phi^{-1}(u)$ is the inverse function for the standard Gaussian distribution. Gaussian observations are independent if and only if they are uncorrelated so therefore, we compute the autocorrelation function for the $u_j s$ and its associated confidence intervals. If the autocorrelation function is indistinguishable from 0, then we conclude that we did not detect any evidence of dependence. We use the Matlab function NORMINV to transform the $u_j s$ to approximate Gaussian random variables and the function ACF which we have provided to compute the autocorrelation function.