BULL. AUSTRAL. MATH. SOC.
VOL. 19 (1978), 295-296.

60G35
(73P05)

Abstracts of Australasian PhD theses

Some stochastic processes arising in neurobiology

Ian William Saunders

As an approach to modelling the "matching" of optical receptors in animals to the objects they are designed to see, we study the problem of locating regions of increased brightness in a random "noise" process. Two different models are considered. The first represents the incoming light by the points of a point process on the real line, and is appropriate for low levels of illumination when individual photons must be considered. The second, appropriate for high light levels, represents the incoming light by a gaussian white noise process. In either case, we study the behaviour of a receptor which measures the total light input within a movable interval of fixed length and define performance measures for this receptor which are analogous to statistical size and power. These measures are then used to define "optimality" for such a receptor.

In the point process case, if the points form a renewal process, we can give conditions on the quantiles of the convolutions of the interpoint distribution which ensure that the optimal receptor has length close to that of the objects it is trying to detect. These conditions are satisfied for a Poisson process. Slightly different conditions ensure that the optimal receptor has length close to zero, and we give a class of distributions satisfying these conditions. We also consider extending the results to two-dimensional point processes, and to the case of more than one receptor.

Received 30 May 1978. Thesis submitted to the Australian National University, May 1978. Degree approved, November 1978. Supervisor: Professor P.A.P. Moran.

The quantile properties of convolutions are themselves of interest and we investigate these in more detail. We further consider quantile properties of gamma and F distributions, and apply the gamma results to a problem arising in bayesian reliability analysis.

The basic results found for the Poisson process model are true also for the gaussian white noise model. However the proofs in the gaussian case are generally simpler and the results more complete.

https://doi.org/10.1017/S0004972700008753 Published online by Cambridge University Press