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SEMIPARAMETRIC INFERENCE FOR SYNCHRONIZATION OF POPULATION CYCLES

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1 Introduction

We consider a dynamic random field. On each of a discrete array of sites is located a hyperbolic dynamical system perturbed by noise. We assume that the dynamics are identical, with a unimodal limit cycle and that the perturbations are independent, centered, and with the same distribution. In addition the individual processes are coupled with one another in a homogeneous pattern. The coupling may be global, in which case we are thinking of a mean-field type of system. Or the coupling may be local, the coupling strength between each site and its neighbors attenuating with distance.

The application we have in mind is to cycling populations of animals, where the log of each local population increases roughly linearly to an apparent critical point from which it falls precipitously to a minimum. The data is discrete in space and time, being based on periodic reports from catchment or reporting regions. In a previous study [1] we focussed on data from Canadian lynx populations. Lynx population cycles are known to follow those of snowshoe hare. Previous analyses of this data have been concerned with inferring the length and regularity of the evident population cycles. We consider in [1] the very different challenge of estimating a parameter identified as strength of coupling among populations. That paper is primarily addressed to data analysis and interpretation.

The emphasis in this report is on the steps involved in arriving at a suitable model and estimator. We explore some of the difficulties posed by this rather unusual problem. In forthcoming studies we, with colleagues, will apply the method described here to cycling population data from Canadian muskrat and mink, and from the greysided vole of Hokkaido.