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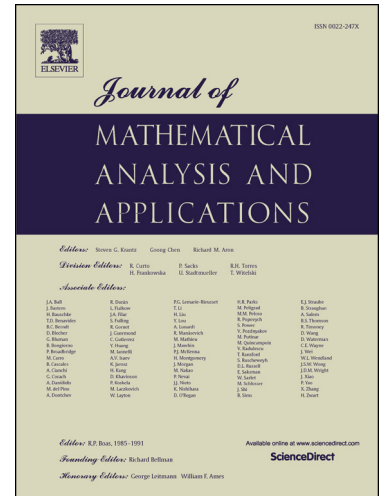
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A Nonlocal Diffusion Model with Free Boundaries in Spatial Heterogeneous Environment

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Abstract

This paper is concerned with the nonlocal diffusive model with double free boundaries in spatial heterogeneous environment, where the spatial heterogeneity is described by the sign indefinite coefficients. Such a model can be used to illustrate the spreading or vanishing of a new or invasive species. Due to the lack of comparison principle in the nonlocal reaction-diffusion equation, many classical methods cannot be used directly to this nonlocal problem. This motivates us to find new techniques. We first establish the spreading-vanishing dichotomy as well as some criteria that ensure the species spreading or vanishing by principal eigenvalues of associated scalar elliptic eigenvalue problems. And then we determine the spreading speed when spreading occurs.

Keywords: Nonlocal diffusion; Free boundary; Spatial heterogeneity; Sign indefinite; Spreading-vanishing dichotomy; Spreading speed

AMS Subject Classification (2000): 35K57, 35R20, 92D25

1 Introduction

We are interested in the effect of spatial heterogeneity on the long-term viability of some species, governed by the following nonlocal diffusive free boundary model

$$\begin{cases} u_t = d\Delta u + u(a(x) - b(x)u - c(x)(\phi * u)), & t > 0, \quad g(t) < x < h(t), \\ u(t, h(t)) = 0, \quad h'(t) = -\mu u_x(t, h(t)), & t > 0, \\ u(t, g(t)) = 0, \quad g'(t) = -\mu u_x(t, g(t)), & t > 0, \\ u(0, x) = u_0(x), \quad h(0) = -g(0) = h_0, & -h_0 \leq x \leq h_0, \end{cases} \quad (1.1)$$

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