Week 5: Spatial models
Assignments for Mathematical Biology, VT19

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1. Consider the reaction-diffusion system given by

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + \gamma \left(\frac{u^2}{v} - bu \right)$$
$$\frac{\partial v}{\partial t} = d\frac{\partial^2 v}{\partial x^2} + \gamma \left(u^2 - v \right)$$

   where γ, b and d are positive constants. For the domain $0 \leq x \leq 1$ with zero flux conditions determine the dispersion relation $\lambda(k^2)$ as a function of the wavenumbers k of small spatial perturbations about the uniform steady state.

2. Consider the coupled system

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + p(u+v)(1-(u+v))$$
$$\frac{\partial v}{\partial t} = (1-p)(u+v)(1-(u+v))$$

   which describes a population consisting of a migratory and stationary sub-population, and p is the probability that a newborn individual is motile. Using the same technique as for the Fisher equation determine the range of possible wave speeds of travelling wave solutions.