**Spatiotemporal Models for Ecologists**

**Simulating Eulerian movement**

Goal: Simulate gridded movement given a preference function

**Data generating process**

Envision a square spatial domain with two spatial dimensions where and . Suppose there’s two mountains such that elevation is:

Where the peaks and and , and is a multivariate normal density function.

Please discretize this spatial domain into grid cells (each in size), and assume that mean-squared-displacement within homogenous habitat. Next, assume the preference function specifies that a species prefers higher elevations, i.e.:

Calculate the density for an individual that starts in time at one peak, i.e., , or between the peaks, i.e., . To do so, use the following steps:

1. Convert to a diffusion coefficient
2. Convert the diffusion coefficient to scale-dependent diffusion-rate
3. Use the scale-dependent diffusion rate to calculate the instantaneous diffusion-rate matrix
4. Use the preference function to calculate the instantaneous taxis-rate matrix
5. Calculate the integrated movement-fraction matrix for discretized time
6. Apply the movement-fraction matrix to an individual vector representing the initial location;
7. Repeat Step-6 to project forwards in time, and visualize the different trajectory given alternative starting points