

Math 456: Topology and Its Applications

Homework 9

Due Friday, November 17th

1. Write a function that produces an $(n \times n)$ symmetric matrix with zero diagonal and all other entries independently sampled uniformly from the interval $[0, 1]$. Use this function to sample 30 matrices of size $n = 30, 50, 70$, and use Eirene to compute and plot the average Betti curves for each set of samples in dimensions $k = 0, 1, 2, 3$. In each case, overlay these on a plot of the (a finite sum approximation of) the predicted limiting distribution $|\sum_{i=0}^{\infty} (-1)^i \binom{n}{i+1} p^{\binom{i+1}{2}}|$ in the range $p \in (n^{-\frac{1}{k}}, n^{-\frac{1}{k+1}})$.
2. Write a function that samples n points uniformly from the unit cube in \mathbb{R}^d and computes the distance matrix for that collection of points. Use this function to sample 30 matrices of size $n = 30, 50, 70$, and use Eirene to compute and plot the average Betti curves for each set of samples in dimensions $k = 0, 1, 2, 3$.
3. Repeat the previous exercise, sampling the points from the standard normal distribution in \mathbb{R}^d .