

Each problem below is worth one failed assignment.

1. **Non-Uniform Sampling with Replacement** (1 bonus point)

Given a finite set $A = \{a_1, a_2, \dots, a_n\}$ and a vector of probabilities of the same size $\mathbf{p} = (p_1, p_2, \dots, p_n)$, a non-uniform sample of size m with respect to probabilities \mathbf{p} is a set S of size m where for each s in S , $P[s = a_i] = p_i$.

Write a function that accepts two arrays, corresponding to A and \mathbf{p} above and an integer m and produces a non-uniform sample from set A with respect to \mathbf{p} of size m . Verify that your function by checking that for large m the proportion of S equaling a_i is approximately p_i .

2. **Kernel Density Estimation in 2D** (1 bonus point)

Create a function that will compute a two dimensional KDE given two arrays, x and y and a bandwidth. Use a bivariate gaussian kernel. The bandwidth in this case will be the common diagonal variance of the gaussian kernel.