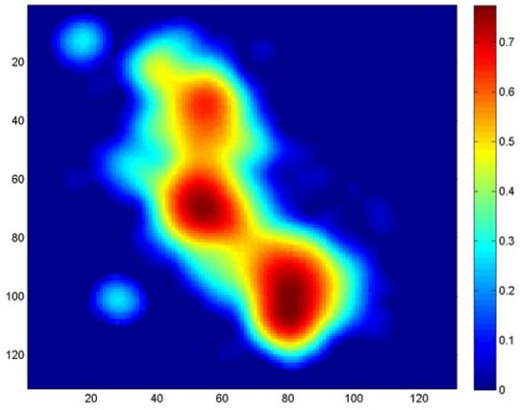
Statistical Computing and Simulation

Spring 2026

Assignment 5, Due June 5/2026

1. First, simulate 100 observations from Beta(2,3) and then use 3 density estimating methods to smooth the observations. You need to specify the parameters in the smoothing methods, and compare the results.

2. 3D and high resolution graphs, as well as density estimation, become more important as the dimension of data increases. Similar to the Maui volcano graph, plot Taiwan's earthquake data (earthquake intensity & depth) and compare the results of 1999 and 2000.



https://www.researchgate.net/profile/Martin-Burger-2/publication/228573658/figure/fig7/AS:667804835532814@1536228488759/Density-estimates-for-earthquake-data-a-Initial-data-Epicentral-distribution-of_W640.jpg

3. Let x be 200 equally spaced points on $[0,2\pi]$ and let $y_i = \sin x_i + \varepsilon_i$ with $\varepsilon_i \sim N(0,0.04)$. Apply at least 3 linear smoothers and compare the differences, with respect to mean squares error (i.e., bias^2 and variance) from 1,000 simulation runs.

4. Use "MCMCregress" in the module MCMCpack to obtain MCMC estimation of regression analysis. Duplicate the analysis in the lecture notes and apply the MCMC on the "bikes" data. Compare your results with the regular simple linear regression.

5. We will apply Bayesian computing (Normal + Normal → Normal) to construct Taiwan's life tables, use Taiwan's mortality data in 2020. Try different prior distributions and compare your analysis results to the official abridged life tables. For example, you may treat the official life table as the prior. Also, you need to specify the parameters used.

6. Similar to the example from the class, we are interested in a mixture of two normal distribution: one is N(0, 1) and the other is N(μ, σ^2), with probability of λ and 1–λ, respectively. Let $\mu = 3$, $\sigma = 1$, and $\lambda = 0.2$ or 0.5. Duplicate the same analysis process in the class notes and comment on the results of kernel smoothing and EM algorithm given that the sample size is 15, 30, or 100.