

## Homework 1: Simulations &amp; Data Visualization

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In this homework you will simulate and visualize data using Matlab (or your preferred coding language).

The ambient dimension of the data will be  $D = 4$ . You may choose the number of samples  $N$ ; I suggest at least  $N = 100$ . The 4 rows in this matrix will contain information about height, weight, glucose level, and a label in  $\{0, 1\}$  indicating healthy or diabetic.

- (a) Generate a  $4 \times 100$  data matrix  $\mathbf{X}$ , initially populated with zeros.
- (b) Populate the first row with i.i.d. random variables  $\mathcal{N}(165, 25)$  (simulating height), and the second row with i.i.d. random variables  $\mathcal{N}(137, 100)$  (simulating weight).
- (c) Does this data make sense? Are all values reasonable? How would you *clean/preprocess* this data?
- (d) Visualize/plot your preprocessed data (in two dimensions).
- (e) Compute the weight/height ratio of each sample, and show its histogram.
- (f) Model/simulate the glucose level of each individual as a noisy version of its weight/height ratio (ratio + noise), and store this value in the third row of your data matrix  $\mathbf{X}$ . Let the noise be i.i.d.  $\mathcal{N}(0, \sigma^2)$ .
- (g) We will model an individual as healthy (label = 0) if its glucose level (as defined above) is below a threshold  $\tau$ , and diabetic otherwise (label = 1). Store these labels in the fourth row of your data matrix  $\mathbf{X}$ .
- (h) Visualize/plot the clustered data (in two dimensions) for different values of  $\sigma$  and  $\tau$ .
- (i) How do  $\sigma$  and  $\tau$  affect the data?