

Mini Project 2 (Type your report in Latex)

Exercise 1 (3 points):

Use R to make a map of Gujarat using an R package showing district-wise characteristic (of your choice). Please mention the source of the data you used to create the map.

Exercise 2 (7 points):

Mixture models form one of the most fundamental classes of generative models for clustered data. This will have a multimodal distribution.

For example, run times on unix servers in 100 universities. The following are run times in seconds:

```
30.16 30.36 97.83 101.59 106.42 30.75 100.10 103.30 101.73 25.48 98.90 31.41
26.33 32.35 96.52 31.93 108.32 99.72 101.11 103.92 97.87 97.83 99.22 97.51 103.24
29.31 29.82 98.42 34.28 27.12 99.28 103.77 102.61 27.22 97.71 105.96 102.41 30.38
101.73 98.59 100.14 99.09 27.44 100.37 99.84 97.34 101.17 99.14 97.41 99.92
101.31 104.61 100.71 30.62 103.57 28.35 108.12 100.05 31.84 28.80
98.47 27.99 105.05 33.33 100.09 23.57 101.68 95.62 102.10 98.77 100.93 98.68
27.00 102.04 100.88 98.79 102.58 27.40 29.01 29.57 97.16 96.60 105.35 97.74
100.97 101.88 96.75 29.01 98.08 99.63 99.41 101.96 26.70 31.66 98.29 103.51
99.28 99.10 33.36 100.36
```

Using mixture normal distribution (a bimodal distribution)

$$0.7 \times N(\mu_1, \sigma_1^2) + 0.3 \times N(\mu_2, \sigma_2^2)$$

(a) (4 points) find the maximum likelihood estimates of the unknown parameters and their standard errors. Use any appropriate R package or otherwise.

(b) (3 points) Draw a histogram of the data and superimpose the density of the above mixture normal distribution using maximum likelihood estimates of the unknown parameters.

Instructions:

- Due date: Monday, September 26, 11:59pm.
- Total points = 10
- Submit a typed report and include any relevant plots.
- Put the R-code at the end.
- You work on the project individually. You must use the following template for your report:

Mini Project #
Name

Provide the R codes in an appendix. Your code must be annotated. No points may be given if a brief look at the code does not tell us what it is doing.