Generalised Regression Models

GRM: Example — MLE **Semester 1, 2022–2023**

Example: Bat detection distance data

To hunt flying insects, bats emit high-frequency sounds and then listen for their echoes. Until an insect is located, the spacing between pulses is about 50 to 100 milliseconds. When an insect is detected, the bat immediately reduces the pulse-to-pulse interval, sometimes to as short as 10 milliseconds. The higher transmission frequency enables the bat to pinpoint the position of its prey.

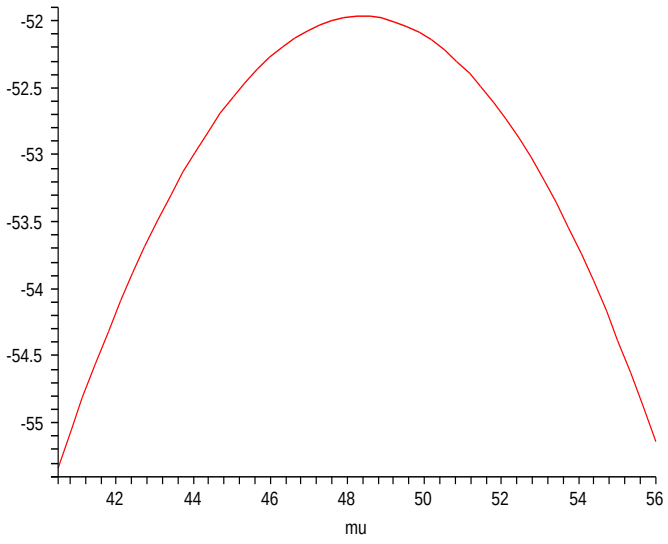
Scientists[1] put a hungry bat and an ample supply of fruit flies into an 11-by-16ft room. Two synchronized 16mm sound-on-film cameras recorded the Drosophila carnage. By studying the two sets of pictures frame by frame, the scientists could follow the bat's flight pattern and simultaneously monitor its pulse frequency. For each insect caught, it was possible to calculate the distance between the bat and the insect at the precise moment the bat's pulse-to-pulse interval decreased. The following data set on detection distances was collected to study how far apart are the bat and the insect when the bat first senses that the insect is there — i.e. what is the effective range of the bat's echolocation system?

Detection distance y_i (cm)	62	52	68	23	34	45	27	42	83	56	40

$$n = 11,\ \sum y_i = 532 \text{ and } \sum y_i^2 = 29000$$

We will assume that the detection distance has a normal distribution with unknown mean μ, and that the variance is known to be $\sigma^2 = 99$.

Plotting the log likelihood



[1] Griffin, D. R., Webster, F. A. and Michael, C. R. (1960). The echolocation of flying insects by bats. *Animal Behaviour*, **8**, pp.141–154.