As a stepping stone to the full data set in Homework 3, here is a simpler example. The measurements are 200 measurements of the same quantity (no time here) and that quantity only depends on two parameters.

By choosing prior distributions $\mu \sim P_\mu$ and $\sigma \sim P_\sigma$ and a likelihood distribution $y_i \sim P(\mu, \sigma)$, build a Bayesian inference model:

$$P(\mu, \sigma | \{y_i\}_{i=1}^{200}) = P(\{y_i\}_{i=1}^{200} | \mu, \sigma)P_\mu P_\sigma.$$  \hspace{1cm} (1)

Using this probability density in a Metropolis-Hastings Markov chain with candidate distribution

$$P_{\text{cand}}(\mu_{n+1}, \sigma_{n+1} | \mu_n, \sigma_n) = N((\mu_n, \sigma_n), \Sigma)$$

where $N(y, \Sigma)$ is a multivariate normal distribution with mean $y$ and covariance matrix $\Sigma$, sample from the posterior distribution. Use those samples to estimate the values of $\mu$ and $\sigma$ used to generate the data.