In this problem, we have a single exponential model,

$$x(t) = Ae^{-t/\tau};$$

which has two fitting parameters A and τ.

Here, least squares method was used to find the fit values A & τ.

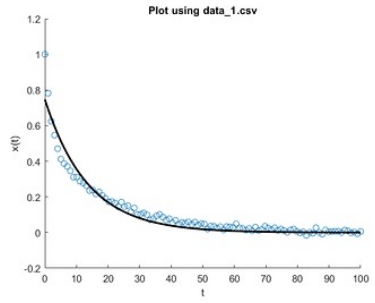
$$\chi^2 = \sum_i \frac{1}{\sigma_i^2} \left[F(t_i) - x_i\right]^2$$

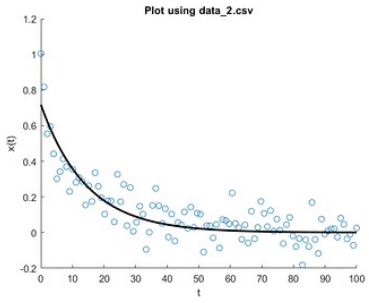
Here, σ_i = standard deviation.

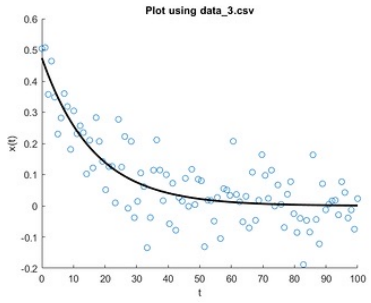
$F(t_i) \rightarrow$ fitting function, in this case $x = Ae^{-t/\tau}$

$x_i \rightarrow$ observed x at timestep t_i

We first minimize the squared error. MATLAB doesn't have a single function that performs a least squared search. So, we had to define a function to do it by defining lsquares (squared error between data & fit) and using the "fminsearch" to minimize that.







And after fitting the datasets to the single exponential model, the graphs shown above were produced.

I have iterated 4 pairs of (A, τ) as initial conditions for each of three datasets. The results of best fit values are listed in a tabular form below:

dataset	Initial values	Best fit
data_1.csv	$A=10,\ \tau=10$	$A=0.7464,\ \tau=13.5134$
	$A=1,\ \tau=10$	$A=0.7464,\ \tau=13.5134$
	$A=10,\ \tau=1$	$A=0.7464,\ \tau=13.5134$
	$A=100,\ \tau=100$	$A=0.7464,\ \tau=13.5135$
data_2.csv	$A=10,\ \tau=10$	$A=0.7167,\ \tau=14.9332$
	$A=1,\ \tau=10$	$A=0.7167,\ \tau=14.9332$
	$A=10,\ \tau=1$	$A=0.7167,\ \tau=14.9332$
	$A=100,\ \tau=100$	$A=0.7167,\ \tau=14.9332$
data_3.csv	$A=10,\ \tau=10$	$A=0.9738,\ \tau=16.3296$
	$A=1,\ \tau=10$	$A=0.9738,\ \tau=16.3295$
	$A=10,\ \tau=1$	$A=0.9738,\ \tau=16.3296$
	$A=100,\ \tau=100$	$A=0.9738,\ \tau=16.3296$