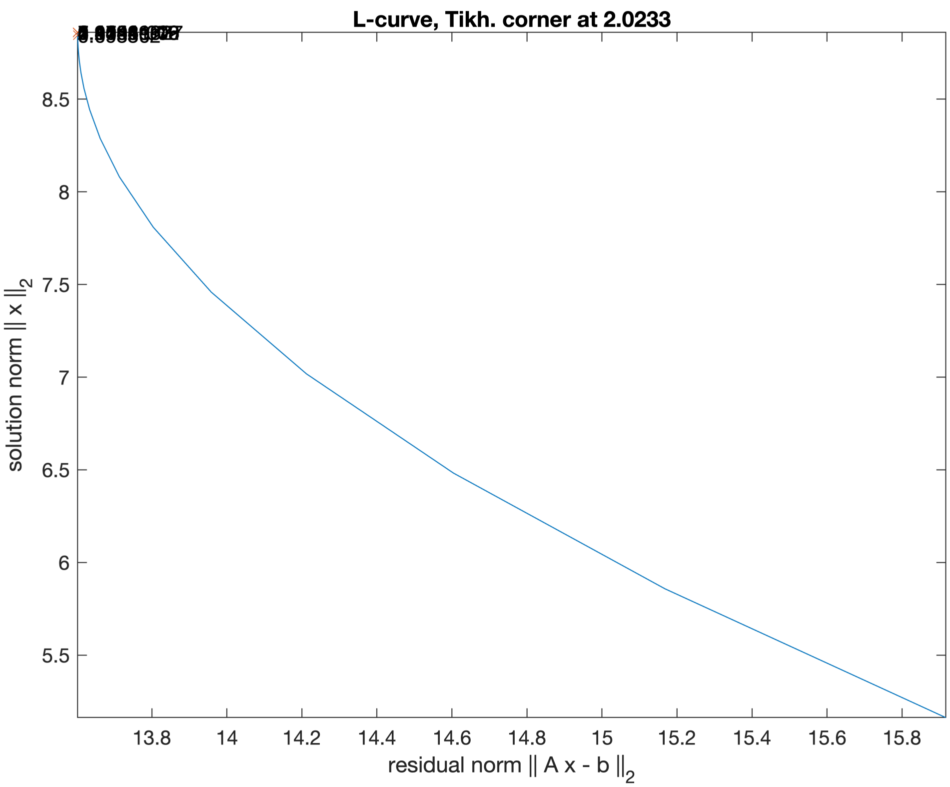
Ch9: Nonlinear inversion, individual activity

1.



The resulting parameter estimates are $m_1 = 2.5411$ and $m_2 = 0.2595$ and these estimates were obtained at 16^{th} iteration.

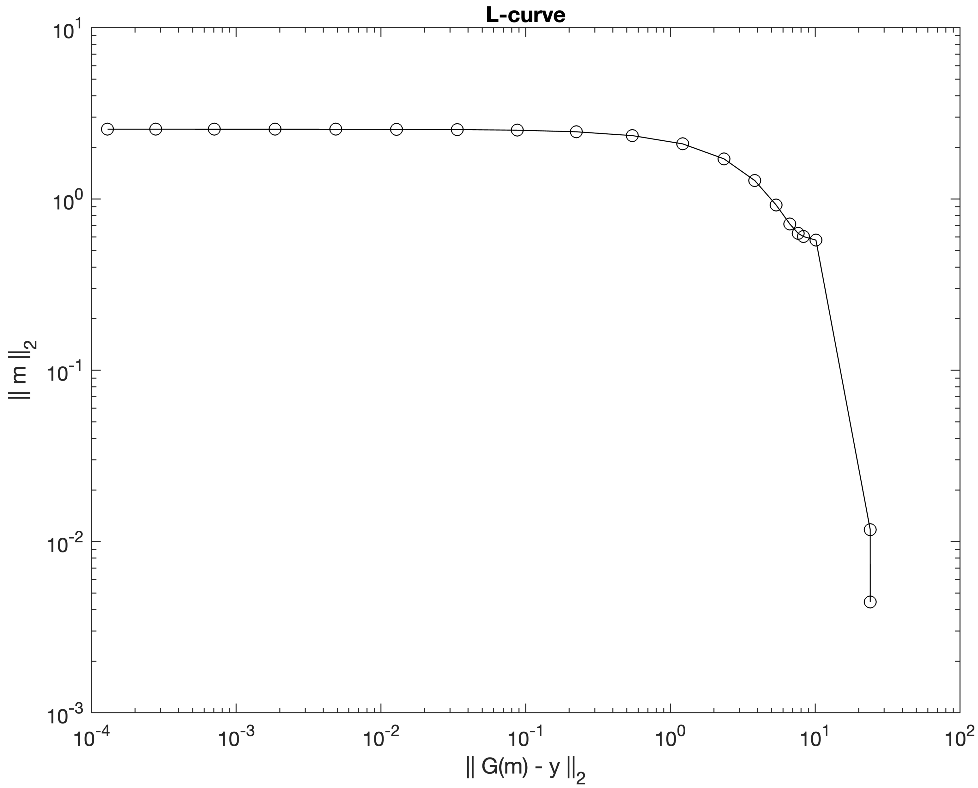
$\chi^2_{\text{obs}} = 6.4847 \times 10^{-9}$ and pvalue = 1.

Since the pvalue=1, this means that model predictions fit the data almost exactly. This maybe as a result of overestimating the data errors or maybe the data was cooked up to fit this model.

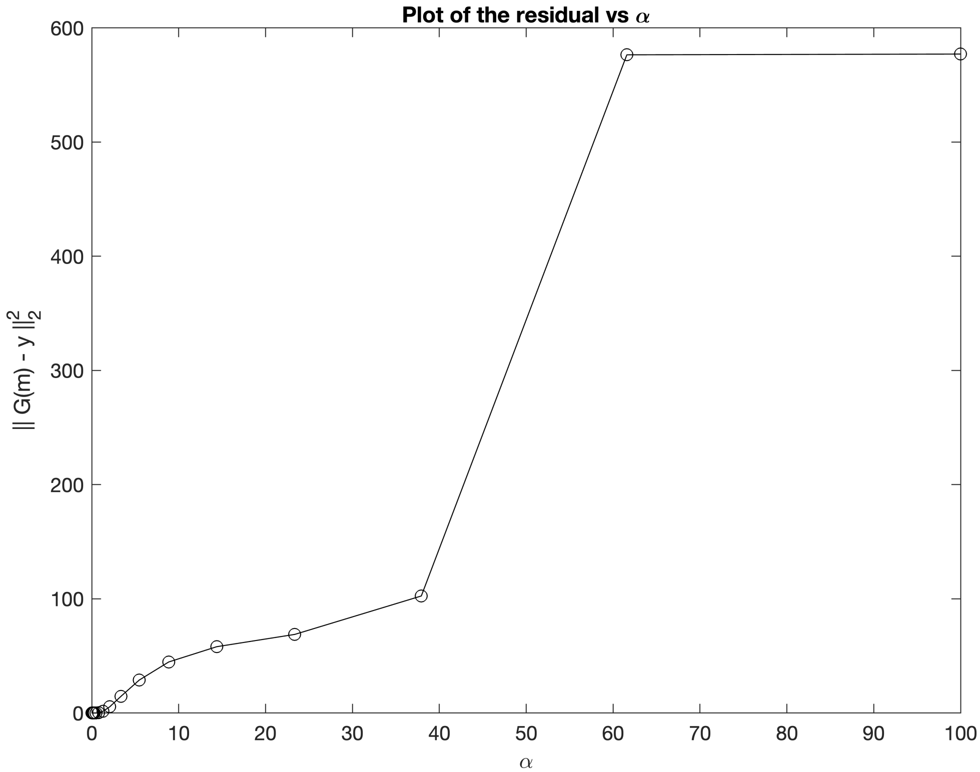
With the same initial conditions, nonlinear inversion takes more iterations to converge to the solution than nonlinear regression and this therefore makes nonlinear regression less computationally expensive than the nonlinear inversion. Another advantage of using nonlinear regression is that this gives better parameter estimates than nonlinear inversion.

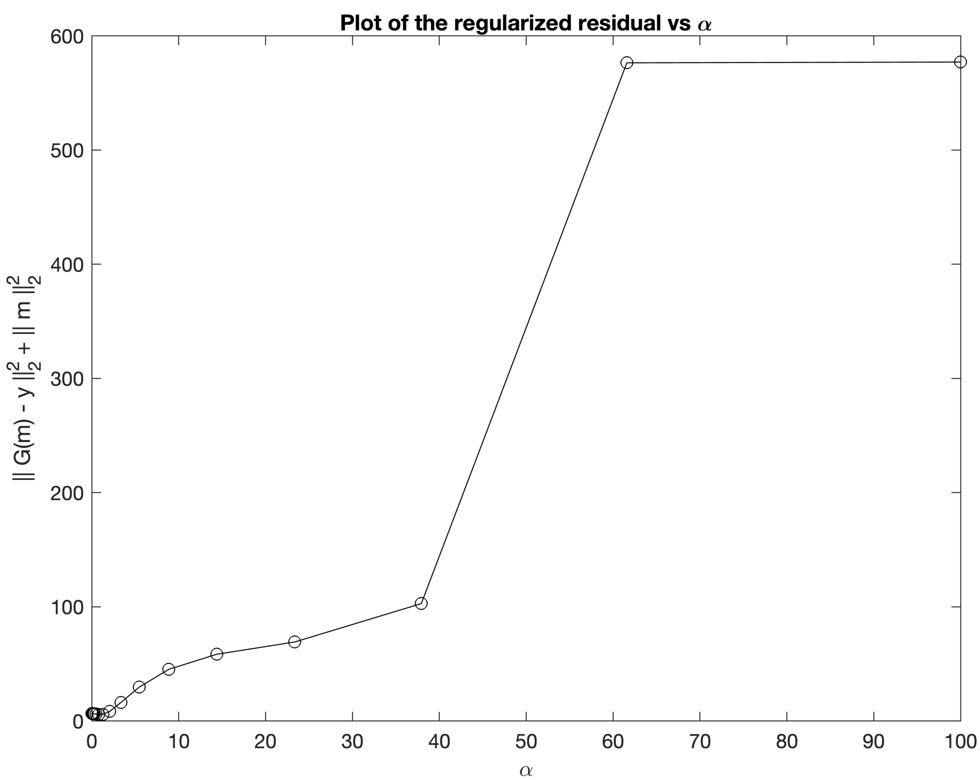
It is easier to obtain α for the nonlinear inversion than guess λ for the non linear regression (i.e for the **Levenberg–Marquardt method**).

2.



Functions $||G(m) - y||_2$ and $||m||_2$ are monoatomic and it is observed that $||m||_2$ is almost constant for the first 10 $\alpha's$ but then starts to decrease for the rest with a rapid decrease between the 18th alpha and the 19th and this forms an inverted L-shape. I would therefore select alpha at the cormer of the L-curve that is at $||G(m) - y||_2 \approx 10^0$.


Plot of the residual vs α
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
α
$|| G(m) - y ||_2^2$


Plot of the regularized residual vs α
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
α
$|| G(m) - y ||_2^2 + || m ||_2^2$

3.

During the iteration process, as alpha decreases the parameters converge to the solution as shown below. And this gives the final parameter estimates as $m_1 = 2.5410$ and $m_2 = 0.2595$.

```
alphas = 1×10
  185.0216  990.4855   94.7609    1.7952    0.0011    0.0000    0.0000    0.0000 ···

m = 2×10
    8.8595   -0.7290    2.5372    2.4767    2.5372    2.5410    2.5410    2.5410 ···
         0    0.2706    0.3069    0.2705    0.2599    0.2595    0.2595    0.2595
```