

## No. 1 a) Approximate the Jacobian with finite differences.

Number of iterations taken = 13

Resulting parameter estimates are [2.5411      0.2595]

chi-square obs = 2.8816e-07

pvalue = 1

Since the value of the p-value is 1, then we reject the null hypothesis, since the fit of the model predictions to the data is almost exact, which is not realistic hence, the parameter estimates are not good.

## 1. b) Report uncertainty estimates: Covariance matrix, confidence intervals, correlation matrix and linearized confidence ellipsoid.

```
covariance_matrix = 2x2
    0.0035    -0.0002
   -0.0002     0.0000
```

Because  $(\sigma_{GN})_1(\sigma_{GN})_2 \neq 0$ , then the computed confidence interval doesn't capture the relationship between  $m_1$  and  $m_2$

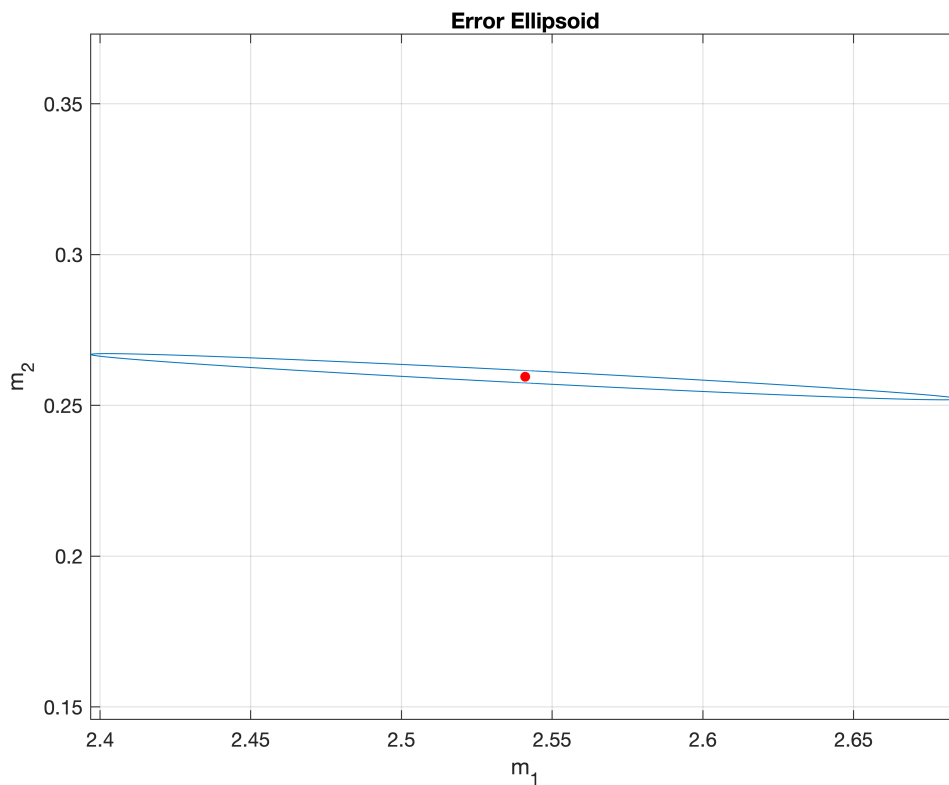
```
confidence_interval_first = 1x2
    2.4256    2.6565
```

```
confidence_interval_second = 1x2
    0.2534    0.2656
```

The estimates lie with in the confidence interval.

```
Correlation_matrix = 2x2
    1.0000    -0.9631
   -0.9631     1.0000
```

The two model parameters are highly negatively statically dependent and correlated, meaning the projection os needle-like with its long principle axis having a negative slope.



The values of the estimates lie at the center of the ellipsoid, which implies that the estimates lie within the confidence region.

## N0.2 Use Levenberg-Marquardt method to fit the data.

The values of the lambda used is 0.4

Number of iterations taken = 1

Resulting parameter estimates are [2.5411      0.2595]

chi-square obs = 2.8813e-07

pvalue = 1

Since the value of the p-value is 1, then we reject the null hypothesis, since the fit of the model predictions to the data is almost exact, which is not realistic hence, the parameter estimates are not good.

**b). Choose initial parameter estimates  $m_1 = 1.6$ ,  $m_2 = 0$ , and through trial and error find two values of  $\lambda$ , of different orders of magnitude, for which the solution converges.**

The values of the first lambda used is 90

Number of iterations taken = 25

Resulting parameter estimates are [2.5411      0.2595]

The values of the second lambda used is 0.85

Number of iterations taken = 61

Resulting parameter estimates are [2.5411      0.2595]

The number of iterations taken for the code to converge depends on the value of  $\lambda$  chosen.