2.

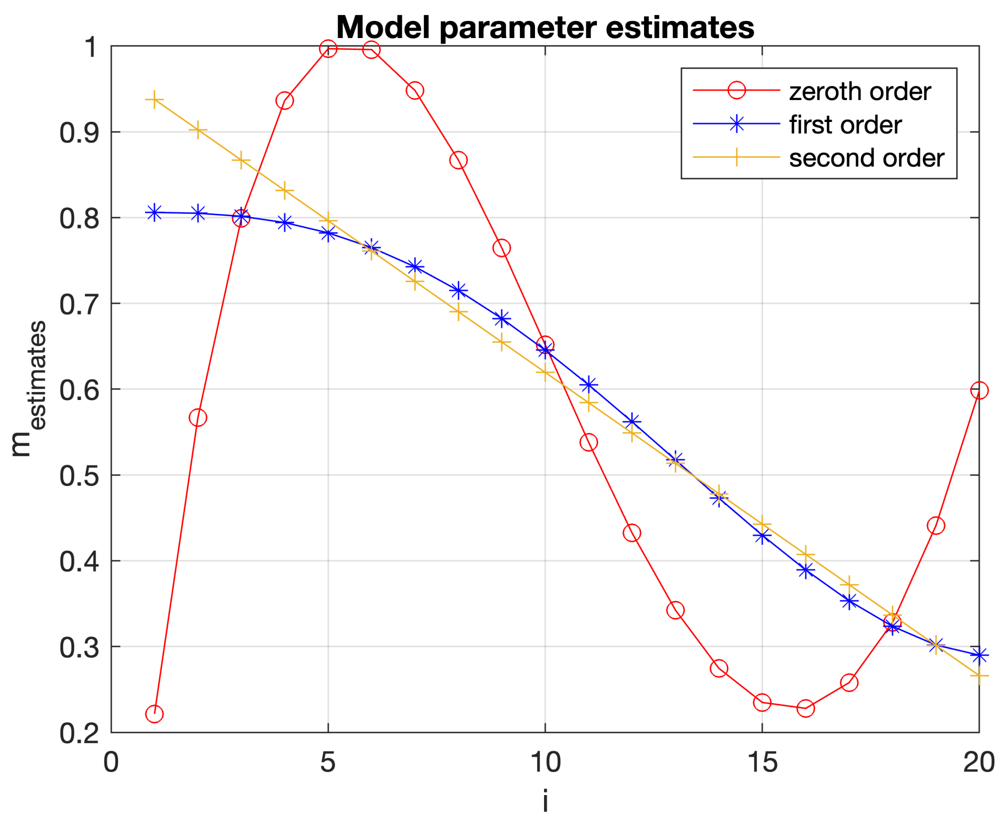
When using the discrepancy principle, I let my value for delta to be 2.0×10^{-7}. The value for alpha that was obtained for this was $\alpha = 2.586 \times 10^{-5}$, is the same for both the first and second order Tikhonov regularizations and it is also equal to the initial value for alpha I used in the fsolve function that is the initial value for alpha that we obtained form the L-curve during the previous activity.

However when using the regularized discrepancy principle with the same initial value for alpha and letting the delta for this case to be equal to 20, I obtained different values for alpha for the first and second order and there given as 0.0168 and 3.0000 respectively.

It is observed that when using the regularized discrepancy principle the values for alpha a bigger than that obtained when using discrepancy principle and the second order Tikhonov regularization has the highest value for alpha.

Since we know that the bigger the alpha, the smoother the parameters become, then the values of alpha obtained when using the regularized discrepancy principle tell us that the parameters estimates from the second order Tikhonov regularization will be smoother than that obtained from the first order.

3.



Since the discrepancy principle gives the same value for all orders, I decided to use values for alpha obtained when using the regularized discrepancy principle and the plots for the parameter estimates from the zeroth, first and second order are as seen above.

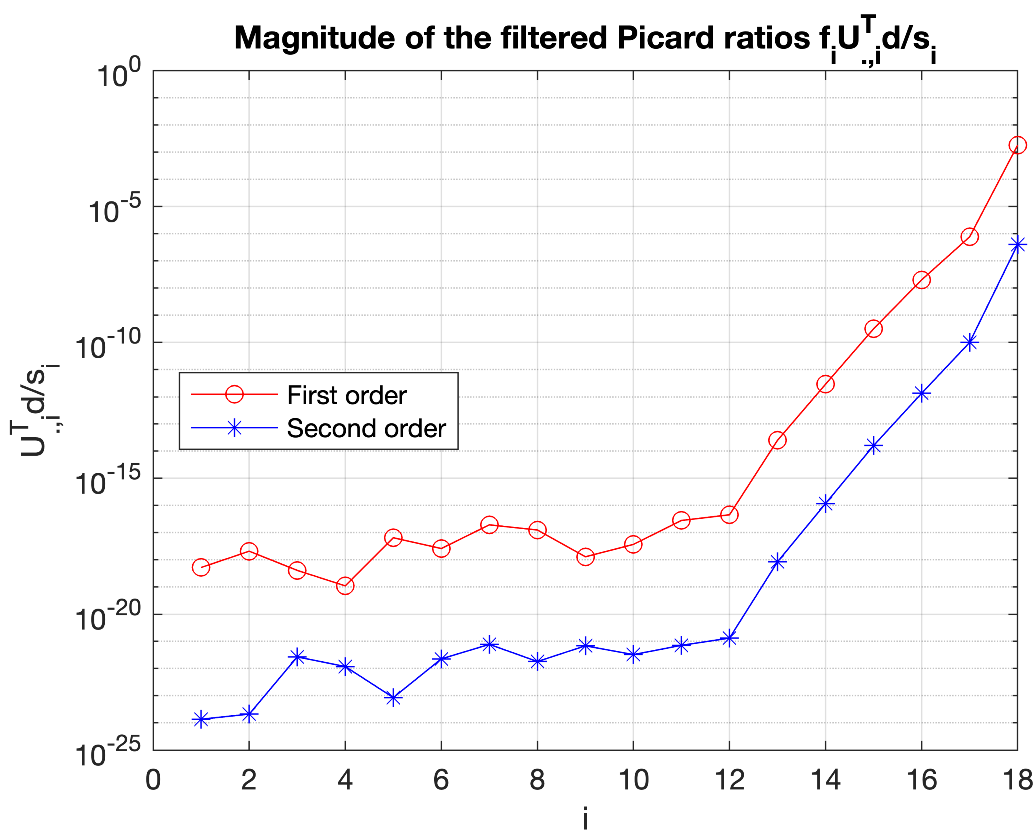
From the graph above, we see that the higher the order, the more linear the curve becomes that is, the smoother the model parameters and the bigger the deviation from true model parameter values. This is in line with what was anticipated basing on the values for alpha in question 2 above.

The model parameters at i = 3,10 and 18 are almost the same when using the zeroth and first order Tikhonov regularizations, and the model parameters at i = 6, 13, 14 and 19 are almost the same when using the first and second order Tikhonov regularizations.

The minimum model parameter estimates for the zeroth order are at i =1 and 16 while as that of the first and second order is at i = 20.

The maximum model parameter estimates for the zeroth order are at i =5 and 6 while as that of the first and second order is at i = 1.

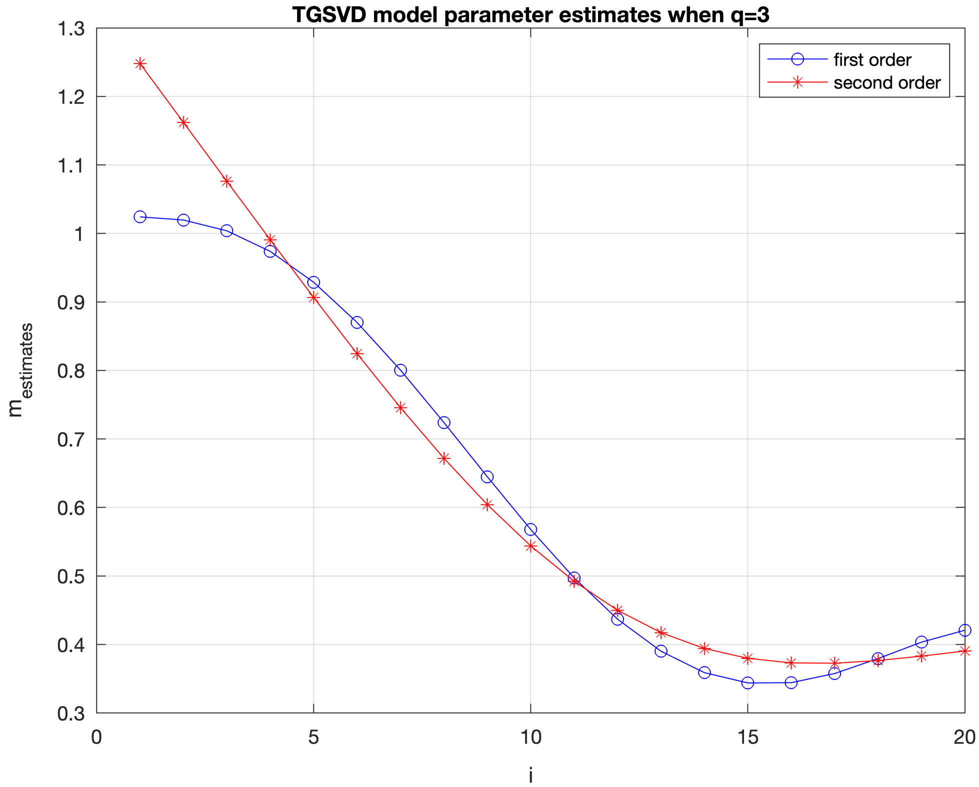
4.

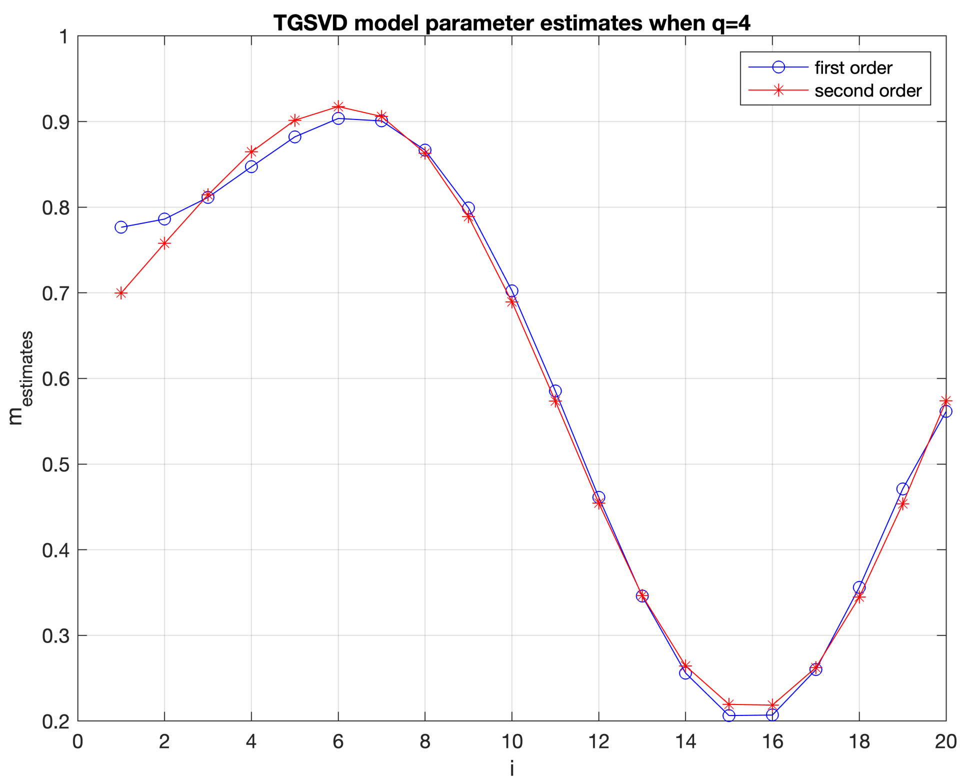


The smaller singular values in the GSVD that may cause the model parameter estimates to become unstable are those at i<13.

I have considered those with picard ratios below 10^{-15}.

5.


TGSVD model parameter estimates when q=3
first order
second order
$m_{estimates}$
i
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0
5
10
15
20


TGSVD model parameter estimates when q=4
first order
second order
$m_{estimates}$
i
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
2
4
6
8
10
12
14
16
18
20

From the two graphs above, it is observed that the parameter estimates for $q=4$ are more accurate and stable than those obtained when $q = 3$. This can be observed from model parameter estimates obtained when $q=4$ starting from $i = 7$ and above.

The smaller the q the smoother the model parameter estimates hence the larger the deviation from true model values.