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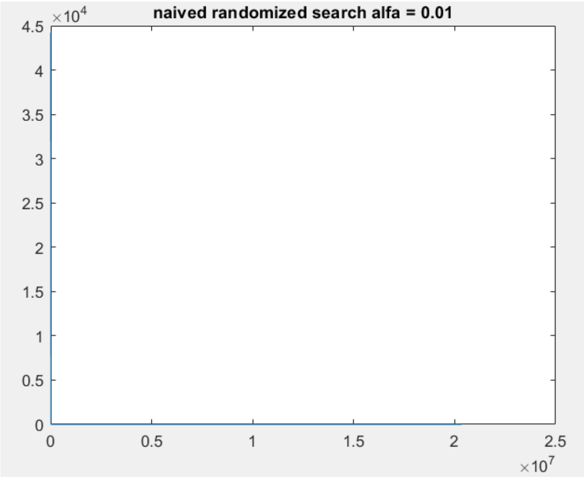
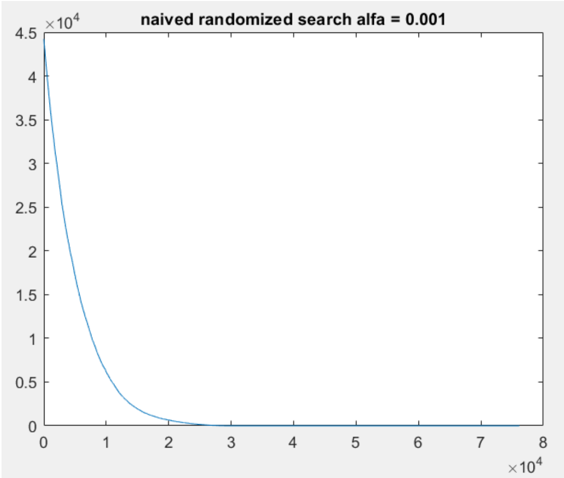
EE 457 HW4 REPORT

P2)

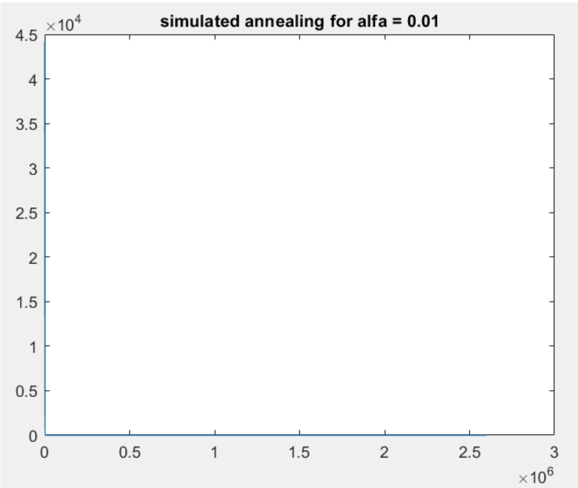
I select a random initial x: $-5 < x_i < +5$ and determine sufficient criteria as that gradient must be lower than 0.01.

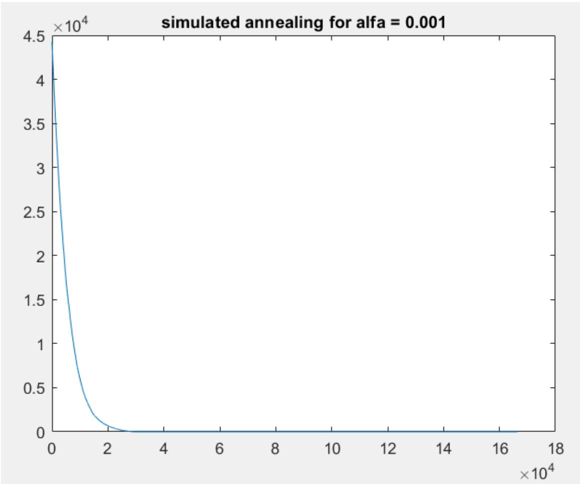
For the naive random search, alfa is 0.01 and 0.001.





For the simulated annealing search, alfa is 0.01 and 0.001 and
probability = exp(-(f(z)-f(x)) / (100/(k+2))) where k is the iteration index.





Search methods	X1	X2	X3	F(x)	#iteration
naive random, alfa =0.01	1.0001	1.0001	1.0002	3.5119e-08	20340432
naive random, alfa =0.001	1.0001	1.0003	1.0005	9.7977e-08	76143
simulated annealing, alfa=0.01	1.0012	1.0025	1.0050	7.7646e-06	2597209
simulated annealing, alfa=0.001	1.0025	1.0049	1.0099	3.0282e-05	166413

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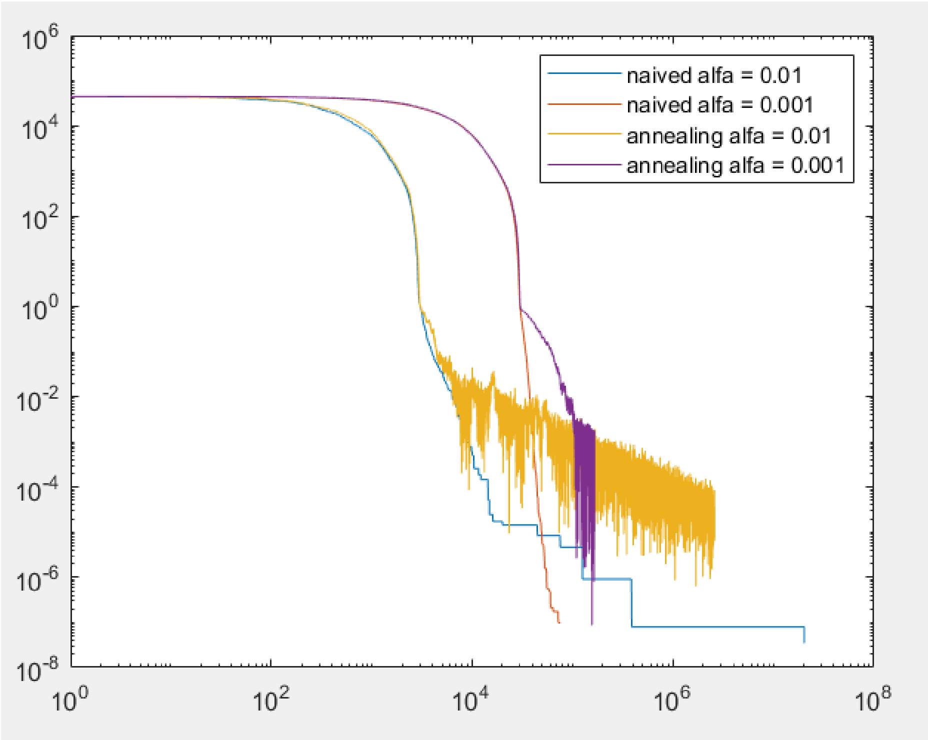
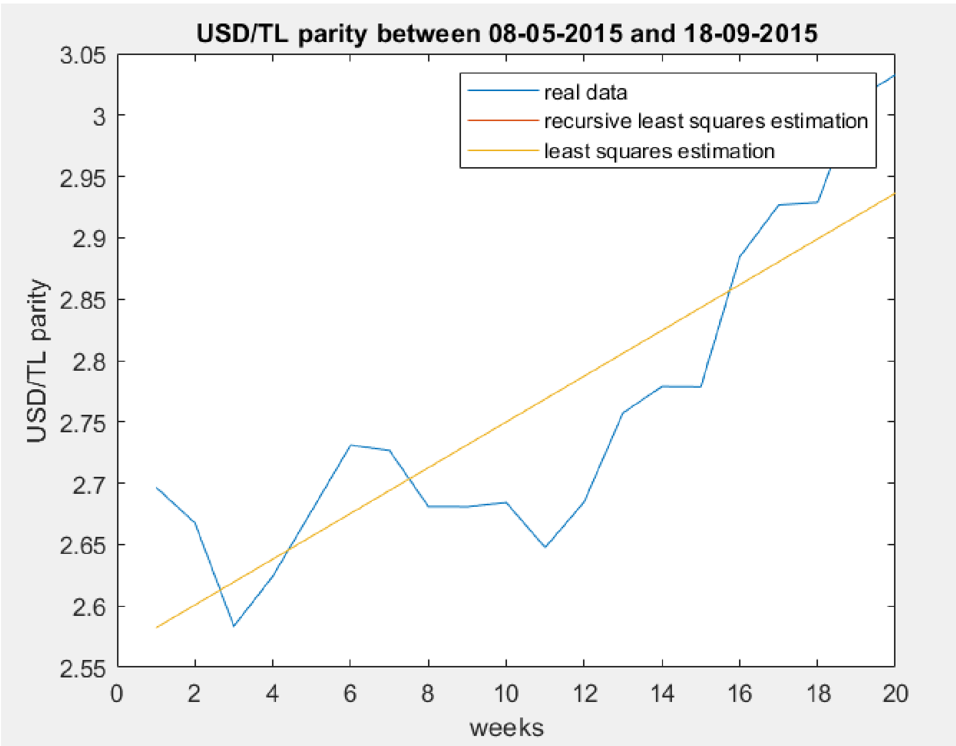
The logarithmic plots for all search implementations:



P3)

The function is 0.0186t + 2.5636 for the recursive least square estimation and least square estimation. The results are same and the lines of these two methods are same.



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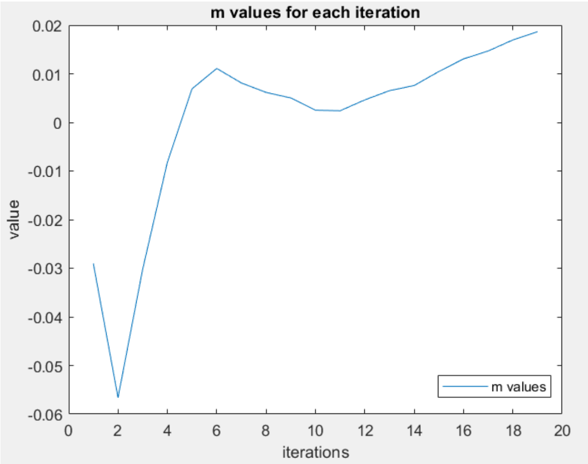
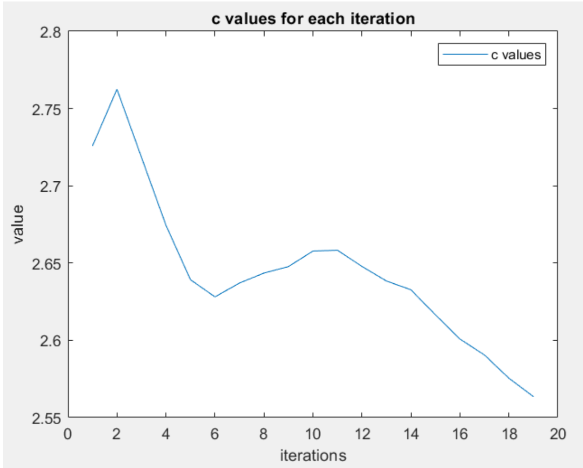
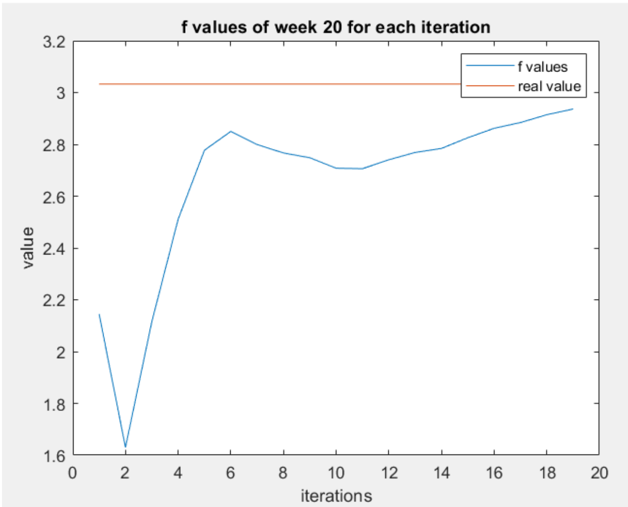
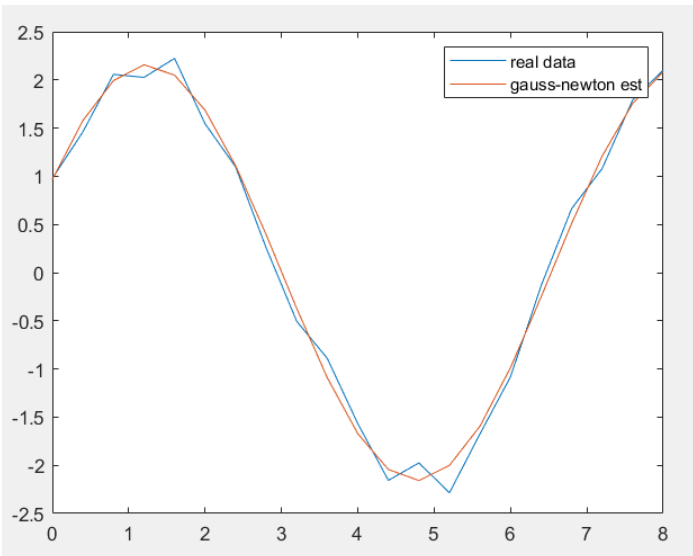




f(t=20) values after each iteration:



P4)The function for Gauss-newton is f(t) = -2.1588*sin(-0.8908t – 0.4641) if the method does not fail because J^TJ is nearly singular or not invertible.



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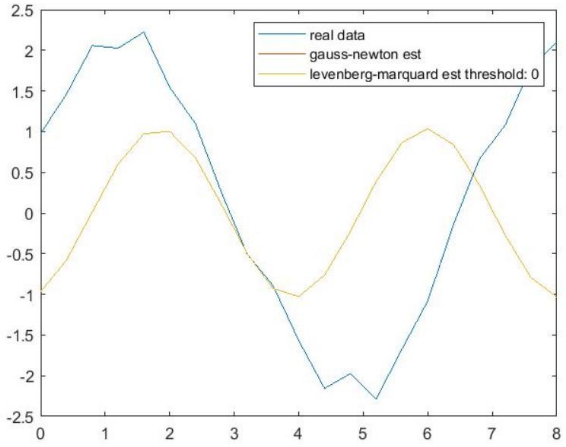
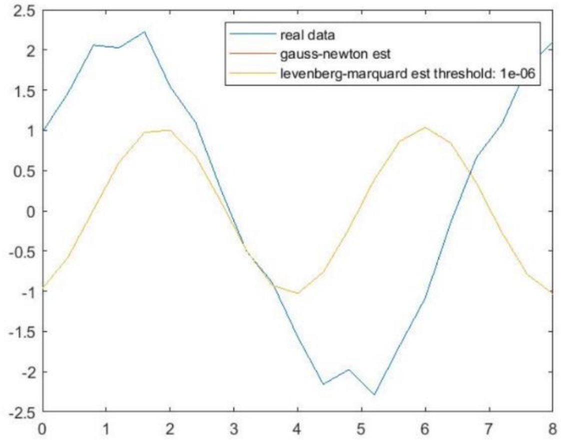
Levenberg-Marquard method is implemented to guarantee that J^TJ is not singular or nearly singular. Theoretically, all eigenvalues must be positive. However, at some cases where minimum eigen value is too close to zero, the method fails although all eigenvalues become nonnegative. I determined a threshold and eigenvalues become higher than this threshold. However, there is not any threshold which is proper for all cases. The results and the convergences depend on this threshold.





At this case, when the threshold is zero and 0.000001 , both of two methods fail and give same results. When the threshold is 0.00001, it changes but still fails. When the thresholds are 0.0001 and 0.001, it gives proper sinus functions fitting the data. When the threshold is 0.01, it dominates J^TJ matrix and the method fails. For this case, proper thresholds are 0.0001 and 0.001. Levenberg-Marquard method works although gauss-newton method fails. The proper threshold values may change for different initial x values. If each method fails, you can make Levenberg-Marquard method works properly by changing the threshold value for the same initial weight.

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