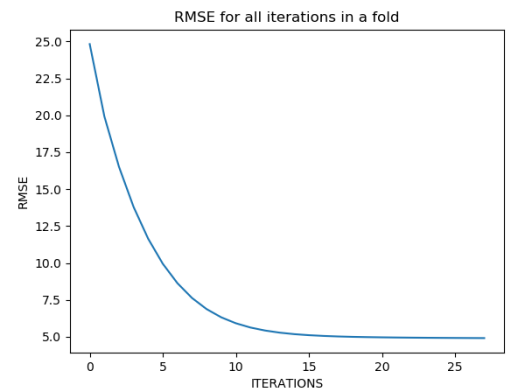
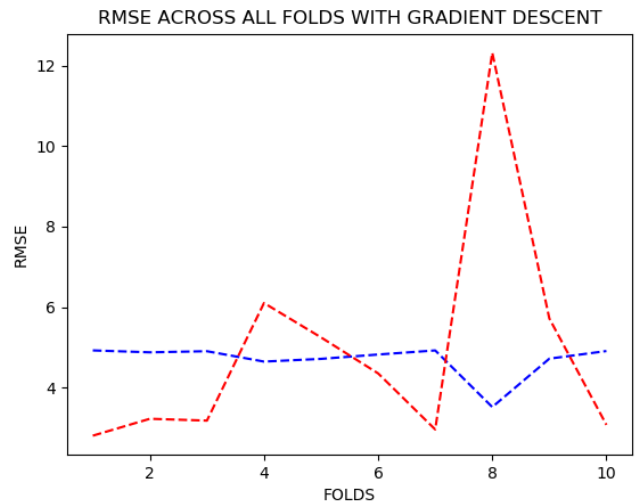


## Assignment 2

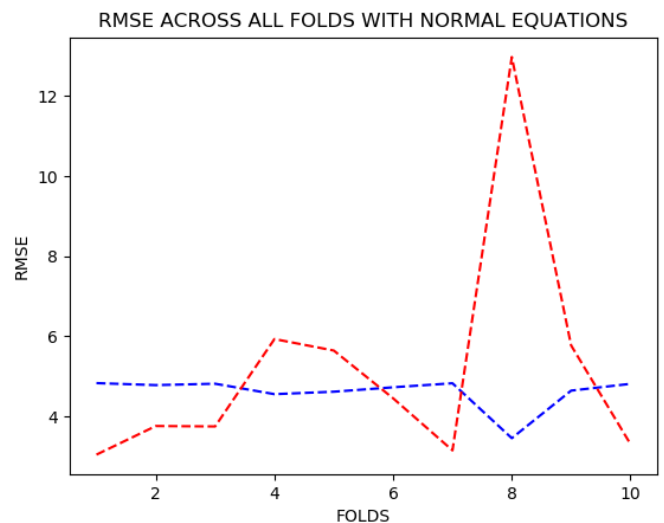
\*Red dotted line – testing results Blue dotted line – training results

### 2.1,3) Housing Dataset:

GRADIENT DESCENT		
Folds	Training RMSE	Testing RMSE
1	4.925585077	2.808117461
2	4.877823933	3.227910471
3	4.90540271	3.182400941
4	4.648014895	6.102370926
5	4.715338214	5.24762768
6	4.823574187	4.354393932
7	4.924806166	2.963138939
8	3.519339708	12.31523469
9	4.72038985	5.717862343
10	4.909781825	3.077228301
Standard Deviation	0.425798541	2.881256665
Average	4.308714101	4.716140214

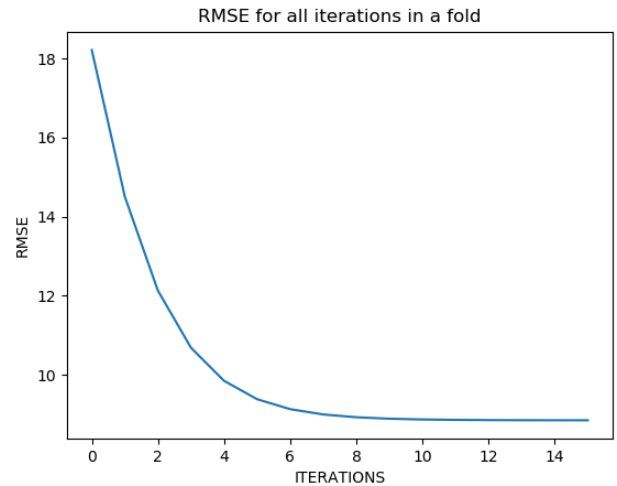
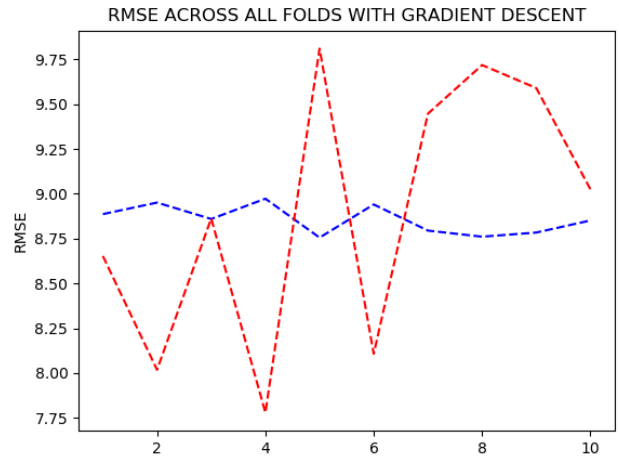


NORMAL EQUATIONS		
Folds	Training RMSE	Testing RMSE
1	4.833554998	3.047443895
2	4.783519547	3.761816762
3	4.81830914	3.751465933
4	4.557600582	5.933545372
5	4.619031207	5.646690803
6	4.729029287	4.453756087
7	4.829826525	3.153970673
8	3.458209934	12.97595691
9	4.646107448	5.773197187
10	4.815502253	3.310659155
Standard Deviation	0.416192279	2.955989396
Average	4.227898473	4.978590197

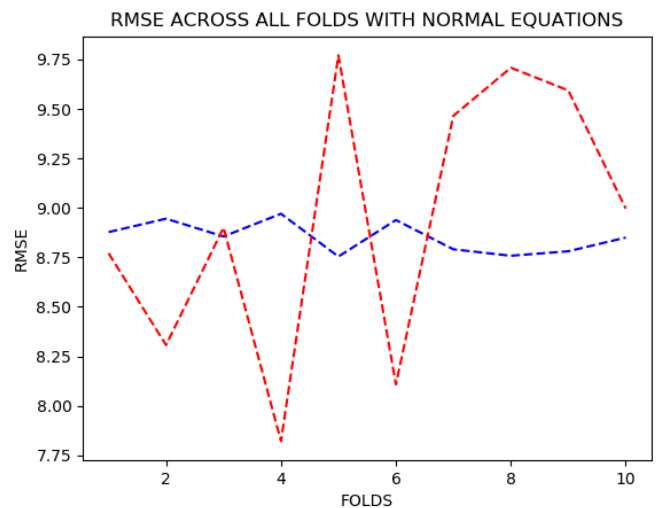


### Yacht Dataset:

GRADIENT DESCENT		
Folds	Training RMSE	Testing RMSE
1	8.886593406	8.652886514
2	8.950891009	8.01841317
3	8.859449457	8.8620699
4	8.97261375	7.779469796
5	8.755631996	9.809810525
6	8.940442882	8.107291913
7	8.794731747	9.446578683
8	8.760623727	9.718018275
9	8.783811167	9.589756462
10	8.8511389	9.024857798
Standard Deviation	0.080855766	0.746151278
Average	8.057889437	8.159573119

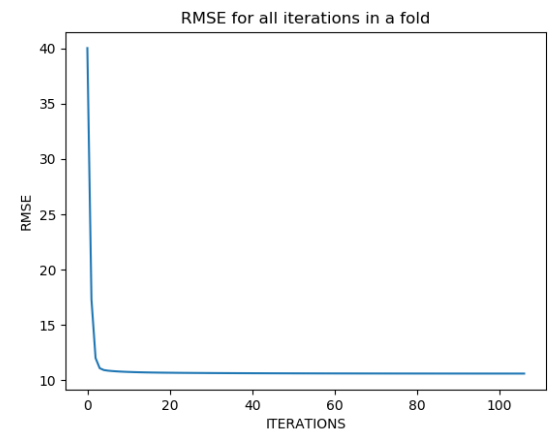
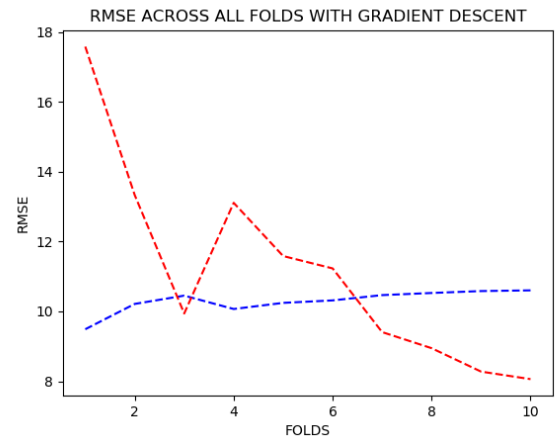


NORMAL EQUATIONS		
Folds	Training RMSE	Testing RMSE
1	8.877689795	8.770711629
2	8.945363307	8.306780943
3	8.855663401	8.900151981
4	8.970427029	7.821314541
5	8.75411482	9.770735716
6	8.938652549	8.107445102
7	8.790712474	9.46510844
8	8.758078042	9.708434769
9	8.780789744	9.593759415
10	8.84993253	8.996582886
Standard Deviation	0.080386355	0.69622833
Average	8.054710004	8.194295796

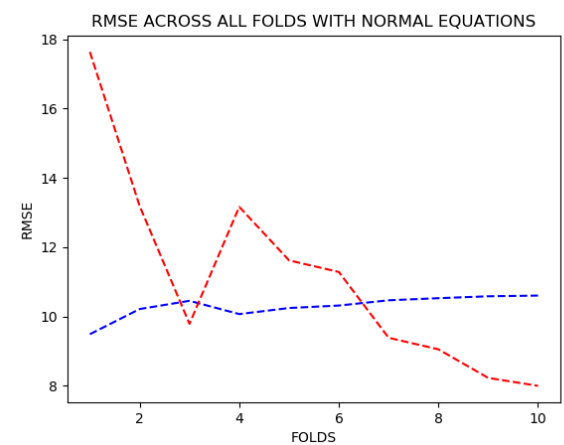


## Concrete Dataset:

GRADIENT DESCENT		
Folds	Training RMSE	Testing RMSE
1	9.488858268	17.58696816
2	10.21535534	13.33251681
3	10.45242326	9.941236158
4	10.06941597	13.11135005
5	10.24513866	11.58641398
6	10.31586422	11.2325172
7	10.46749394	9.407558639
8	10.52845422	8.946895553
9	10.58329819	8.275952552
10	10.6037202	8.060174801
Standard Deviation	0.332906129	2.932577832
Average	9.391175307	10.40128743



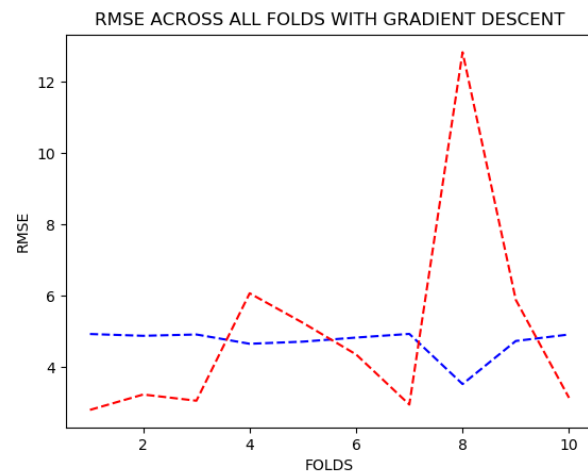
NORMAL EQUATIONS		
Folds	Training RMSE	Testing RMSE
1	9.486549859	17.63431988
2	10.21301378	13.18357527
3	10.44975231	9.785694511
4	10.06693623	13.16258689
5	10.24238624	11.61704962
6	10.3133705	11.28246325
7	10.46525823	9.383387662
8	10.5258824	9.049639639
9	10.58091075	8.225172938
10	10.60132976	7.995842426
Standard Deviation	0.332875639	2.950741084
Average	9.388933245	10.38822483



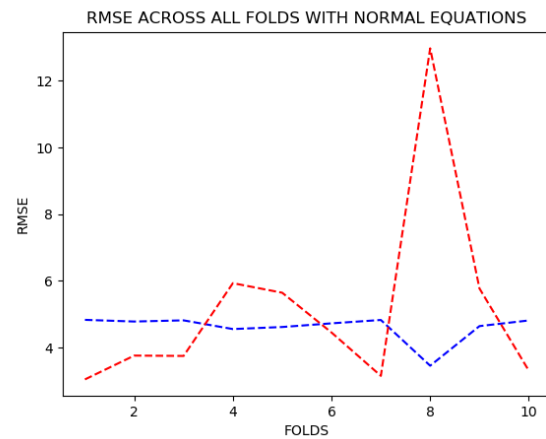
2.2)

1)

With weights all 1



With weights all -1

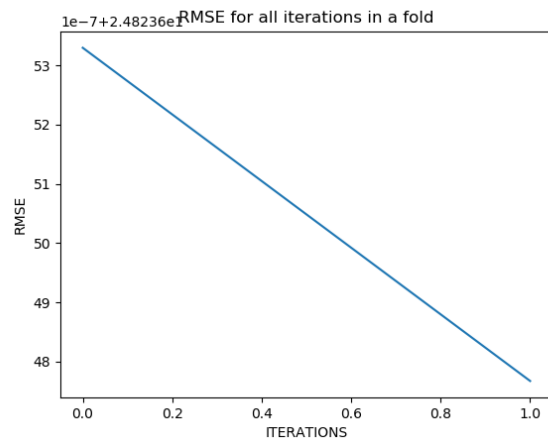


As suggested by the above diagrams the starting weight does not have much impact on the results.

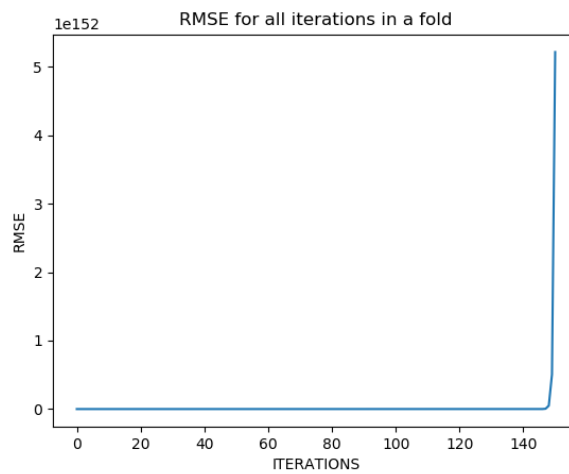
2) As suggested from the RMSE for all iterations in a fold graph almost all the folds for all dataset do not execute till the full 1000 iterations and gets cut off within 25-30 iterations. This suggests that in most of the folds the threshold was the breaking criteria. So, it does highly affect the results.

3)

Learning Rate: 0.00000000004



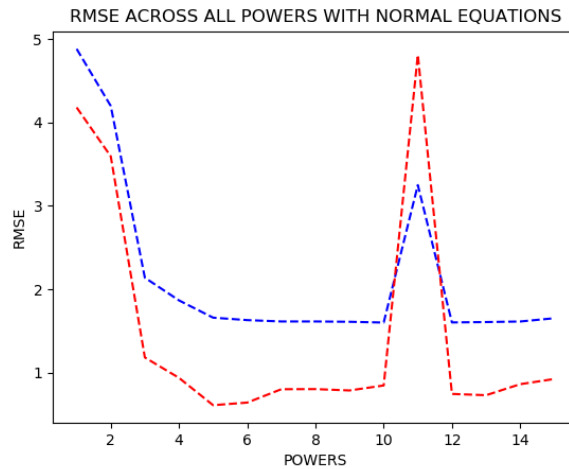
Learning Rate: 0.004



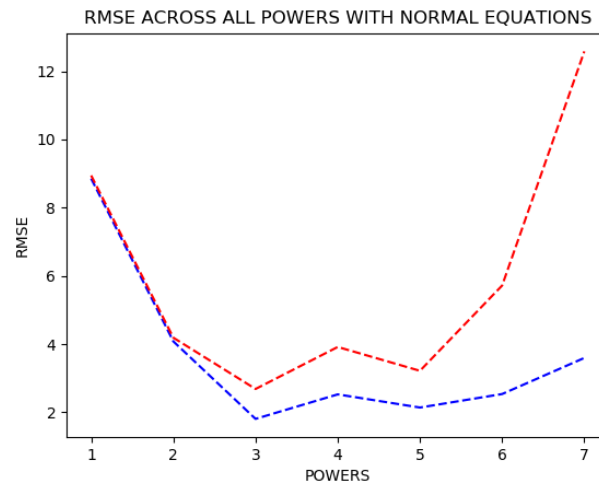
The algorithm is sensitive to the learning rate. A higher value of learning rate leads the algorithm to oscillate between intermediate values and a very smaller value of learning rate leads the algorithm to converge very slowly.

5.1)

Sinusoid Dataset:



Yacht Dataset:



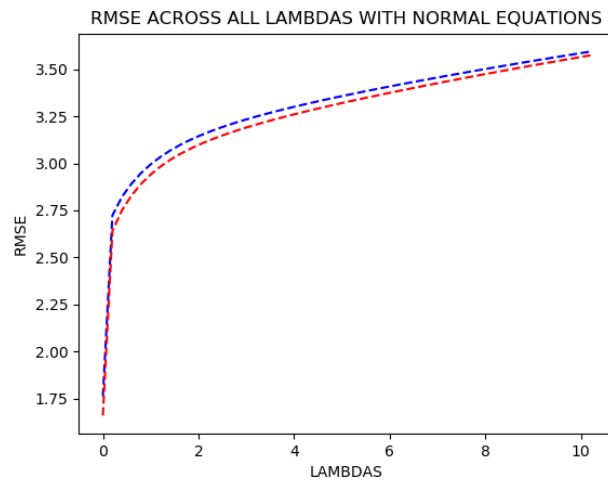
5.2)

1) Addition of new features with increasing power, decreases the RMSE till a certain power and increases after that. Yes, the impact is almost similar for both the training and the test data.

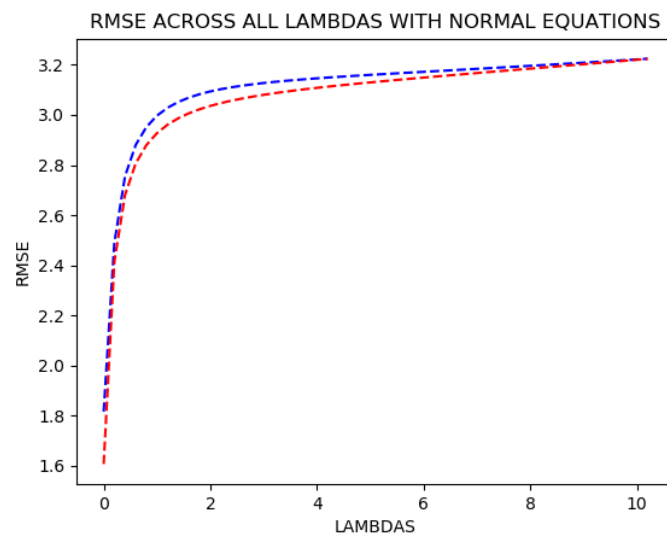
7)

1)

For  $\max(p) = 5$



2) for  $\max(p) = 9$



7.1) Higher the value of lambda , bigger the penalty and therefore the magnitude of the coefficients is reduced. Therefore smaller value of lambda produces less RMSE. In both the cases of the synthetic data we created the RMSE graphs follow an identical path.