1) i)

Cost: [[0.125]]
Cost: [[0.5]]
Cost: [[1.125]]
Cost: [[2.]]

ii)

Cost: [[1.125]]
Cost: [[0.125]]
Cost: [[3.125]]
Cost: [[10.125]]

2)

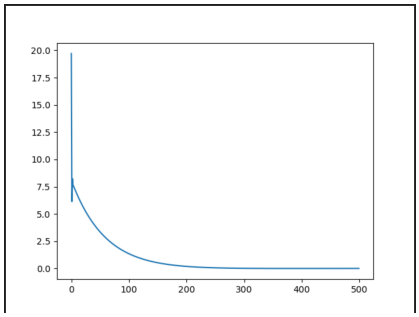
theta: [[0.80832913]
[0.76397009]
[0.6924307]]
cost: [[2.73878871]
[2.51053929]
[2.30460754]
[2.11867246]
[1.95066367]
[1.79873381]
[1.6612339]
[1.53669158]
[1.42379164]
[1.32135883]
[1.22834252]
[1.14380311]
[1.06689989]
[0.99688034]
[0.93307049]]

3) Theta = [[-6.66133815e-15]
[1.00000000e+00]
[1.00000000e+00]]

There is a significant difference between my results in two and three because of the variance the gradient descent algorithm has due to its other parameters such as the learning rate alpha and the number of iterations for the gradient descent algorithm to run on.

4c) Feature matrix size: m x (n + 1), where m = # of training samples and n = # of features. Therefore, feature matrix X is of size (178,2) with all 1s in the first column to represent X0. Label vector y is of size m x 1, where m = # of training samples.

4e) theta = [[-6.2844622]
[19.110854]]



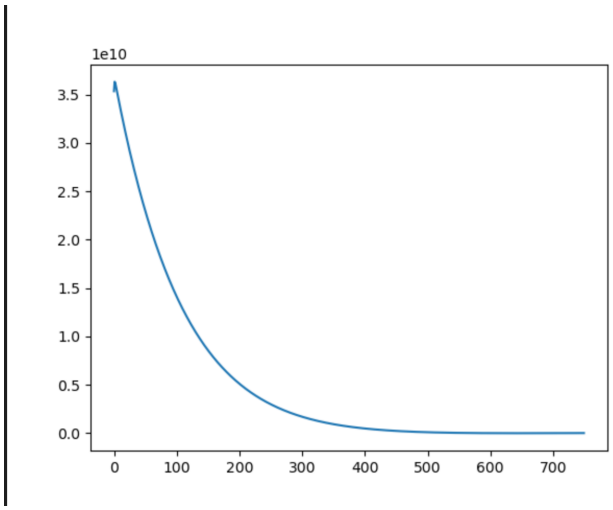
4f) Prediction error: 45.22941689539784

4g) Prediction error: 41.59926986642115
The prediction errors are almost identical because the normal equation and gradient descent are two separate equations, however, they achieve the same goal in finding the optimal theta values to minimize the cost function and minimize our prediction error.

4h)The cost associated with the lowest alpha rate is also the lowest, therefore, in this scenario it would be best to use a lower alpha rate so our gradient descent algorithm can converge at a low cost. The cost associated with the higher alpha rate converges at a much greater cost when a =3 because our learning rate is too high. Alpha=.001 is the best alpha to use with our data.

5a) mean_size:2000.6808510638298
mean bedrooms: 3.1702127659574466
mean price: 340412.6595744681
std size: 786.2026187430467
std bedrooms: 0.7528428090618781
std price: 123702.5360061474
X size: (47,3)
Y size: (47,1)

5b) theta: [[363871.86125726]
[122040.68435921]
[-22232.23310183]]



5c) Predicted price: 252371.71139809