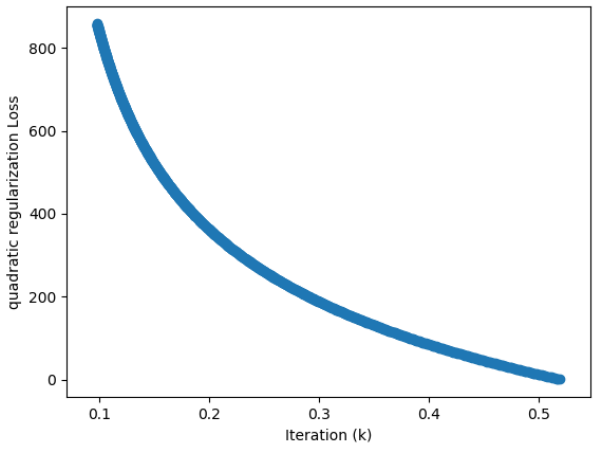
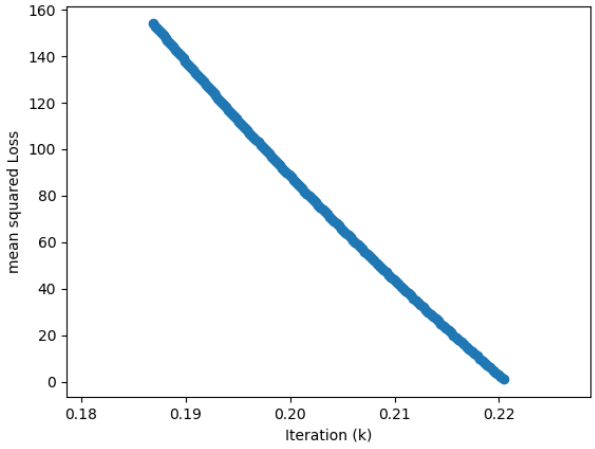
Problem 1

- The quadratic loss chart



- Mean Squared loss chart



- Gradient for Lazzo Regularization

$$\frac{\partial J(\theta)}{\partial \theta_j} = \frac{1}{m} \sum_{i=1}^{m} \left(h_\theta \left(x^{(i)} \right) - y^{(i)} \right) x_j^{(i)} + \frac{\lambda}{2m} \tag{1}$$

- Non zero trained parameters for quadratic regularization

A1 average annual precipitation in inches	-0.35398382
A2 average January temperature in degrees Fahrenheit	0.41328217
A3 average July temperature in degrees Fahrenheit	-0.35784936
A4 percent of 1960 SMSA population 65 years old or older	-0.45132795
A5 household size, 1960	0.19444133
A6 schooling for persons over 22	0.51483471
A7 household with full kitchens	1.25468456
A8 population per square mile in urbanized areas	-0.71296868
A9 percent nonwhite population	0.35647023
A10 percent office workers	-1.21424232
A11 poor families (annual income under $3000)	0.83602323
A12 relative pollution potential of hydrocarbons	-0.43252622
A13 relative pollution potential of oxides of Nitrogen	-0.85848936
A14 relative pollution of Sulfur Dioxide	0.61454347
A15 percent relative humidity, annual average at 1pm	0.13105203

- Non zero trained parameters for Lazzo regularization

A1 average annual precipitation in inches	-0.12792469
A2 average January temperature in degrees Fahrenheit	1.95761968
A3 average July temperature in degrees Fahrenheit	-0.50244335
A4 percent of 1960 SMSA population 65 years old or older	-0.48431719
A5 household size, 1960	0.19444133
A6 schooling for persons over 22	0.51483471
A7 household with full kitchens	1.25468456
A8 population per square mile in urbanized areas	0.56910767
A9 percent nonwhite population	0.53750671
A10 percent office workers	-0.64958766
A11 poor families (annual income under $3000)	0.73270299
A12 relative pollution potential of hydrocarbons	-2.78282742
A13 relative pollution potential of oxides of Nitrogen	1.4834403
A14 relative pollution of Sulfur Dioxide	0.89733701
A15 percent relative humidity, annual average at 1pm	0.42368897

Problem 2

- Gini index of wine: 0.7200000000000095
- Gini index of running: 1.2800000000000118
- Gini index of pizza: 0.31999999999997897
- Should split at root based on **pizza** because it has the lowest GINI index.