Intro to ML

PS2 Report

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Questions:

1. Cost of case i: 29.66

Cost of case ii: 14.875

1. Theta estimates: *theta begins at a random number between -1 and 1*

Theta0 = 1.02

Theta1 = 0.509

Cost after 15 iterations:

22.48

1. Theta estimates:

Theta0 = 4

Theta1 = 2

There is a significant difference between the estimates from gradient descent and the normal equation. That difference is because gradient descent only iterated 15 times with a learning rate low enough that it didn’t get to fully descend to the minimum cost. I would need to run the gradient descent algorithm more times to get the functions to give the same result.

1. .
   1. .
   2. Image output

A graph of a car

Description automatically generated

**ps2-4-b.png**

* 1. Feature matrix X: (179,2) Label vector y: (179,)
  2. .
  3. Image Output

A graph with a blue line

Description automatically generated

**ps2-4-e-1.png**

A graph of a graph with red dots

Description automatically generated

**ps2-4-e-2.png**

* 1. Mean Square Prediction Error: 28.9
  2. Normal Mean Square Error Prediction: 26.7. The error for this method of linear regression is slightly lower than gradient descent, because this method provides the exact solution for the optimal line of best fit. That in combination with limited iterations on gradient descent make the normal equation solution a stronger fit.
  3. The larger the value of alpha, the cost minimizes quickly. The smallest learning rate (a = 0.001) is too slow and never reaches a low cost after 500 iterations. The learning rate (a = 0.003) also suffers from being too slow. The learning rate (a = 0.3) achieves the lowest cost without diverging and is a sufficient selection as a learning rate.

A graph with a blue line

Description automatically generated A graph with a blue line

Description automatically generated

**ps2-4-h-1.png ps2-4-h-2.png**

A graph with a blue line

Description automatically generated A graph with a blue line

Description automatically generated

**ps2-4-h-3.png ps2-4-h-4.png**

1. .
   1. House size mean: 2000 square feet

House size std: 786.2

House bedrooms mean: 3.17 bedrooms

House bedrooms std: 0.75

Feature matrix size: (47, 3)

Label vector size: (47, 1)

* 1. Theta0 = 340,231

Theta1 = 14,249

Theta2 = -8,398

A graph with a blue line

Description automatically generated

**ps2-5-b.png**

* 1. Normalized data:

Sq. feet = (1080 – 2000) / 786.2 = -1.17

Bedrooms = (2 – 3.17) / 0.75 = -1.56

Cost Prediction = 340,231 + 14,249(-1.17) + (-8,398)(-1.56)

Cost Prediction = $336,660