FPT QUY NHON UNIVERSITY
ARTIFICIAL INTELLIGENCE

FPT Education
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MAI391

ASSIGNMENT 03

Topic:

LINEAR REGRESSION

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Contents

1. Problem Statement

- Implementing Gradient Descent and Linear Regression using Python with Collected Data.

2. Data Source and Prepare Data

2.1 Data Source

- Data link:

github.com/thangthewinner/MAI391_AS03/blob/main/data/stock21_clean.csv

- The dataset contains information related to stocks currently listed on the Vietnam stock exchange in 2021.

2.2 Prepare Data

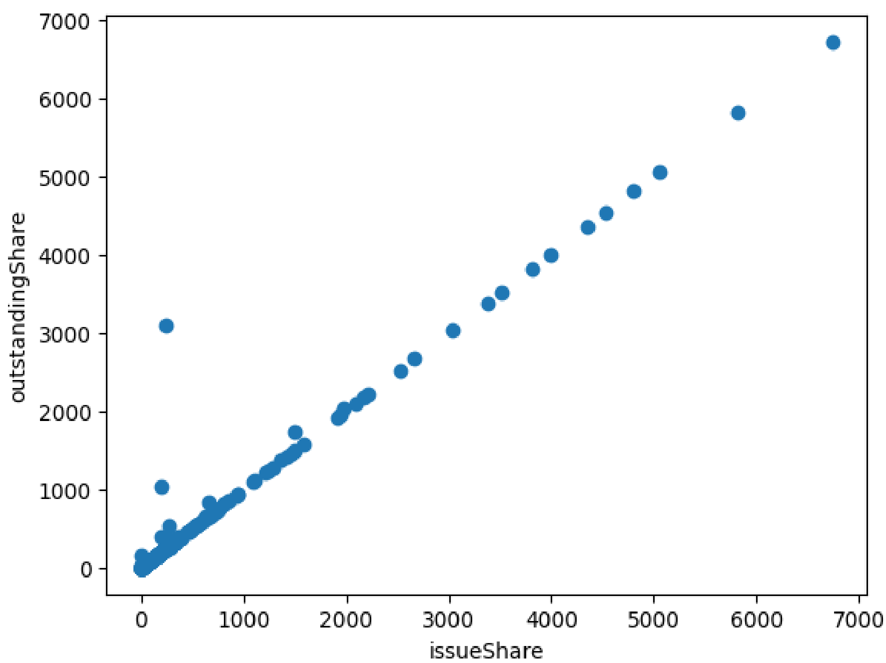
- After observing and performing some statistics on the data, We discovered that Issue Share and Outstanding Share have a linear relationship with a correlation of up to 0.98. Therefore, we decided to use the two attributes for this task.

3. Descriptive Statistics

- Issue Share: The number of shares the company has issued since its establishment until now.

- Outstanding Share: The number of shares currently outstanding in the market.

- Scatter plot between Issue Share and Outstanding Share:



- Looking at the scatter plot, we see that as the issue share increases, the outstanding share also increases. This makes it very suitable for creating a linear regression model.

4. Gradient Descent

4.1 Normalize Data

- From the scatter plot we can see that issueShare and outstandingShare all in range from 0 to 7000. This will make prediction difficult and time-consuming due to excessively large values. Therefore, what we need to do is normalize it to be within the range of -1 to 1.

- Normalization formula:

$X_{norm} = \frac{X-\mu}{\sigma}$ - Through this formula, we have created a function to normalize the data.

4.2 Compute Cost Function J(θ)

- The formula of the cost function for linear regression is given by:

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^{m} \left((\theta_0 + \theta_1 x^{(i)}) - y^{(i)} \right)^2$$

- Through this formula, we have created a function to compute the cost of the data.

4.3 Gradient Descent

- The update formula for parameters θ in the gradient descent algorithm is:

$$\theta := \theta - \alpha \nabla_\theta J(\theta)$$

- Through this formula, we have created a function to update formula for parameters θ of the data.

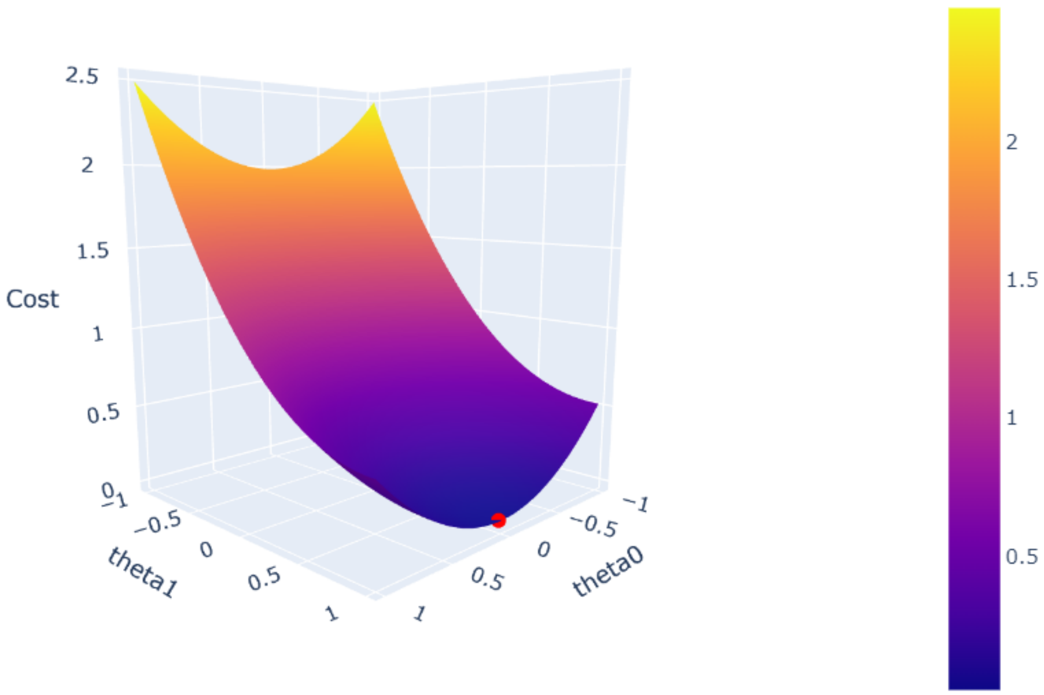
- Test gradient descent for 1500 iterations with a learning rate (alpha) of 0.01:

```
Iteration: 0, Cost: 0.01598548726633169
Iteration: 100, Cost: 0.01598548726633169
Iteration: 200, Cost: 0.01598548726633169
Iteration: 300, Cost: 0.01598548726633169
Iteration: 400, Cost: 0.01598548726633169
Iteration: 500, Cost: 0.01598548726633169
Iteration: 600, Cost: 0.01598548726633169
Iteration: 700, Cost: 0.01598548726633169
Iteration: 800, Cost: 0.01598548726633169
Iteration: 900, Cost: 0.01598548726633169
Iteration: 1000, Cost: 0.01598548726633169
Iteration: 1100, Cost: 0.01598548726633169
Iteration: 1200, Cost: 0.01598548726633169
Iteration: 1300, Cost: 0.01598548726633169
Iteration: 1400, Cost: 0.01598548726633169
theta0:  2.782399344117694e-17
theta1:  0.9838846606525207
```

4.4 Visualizing

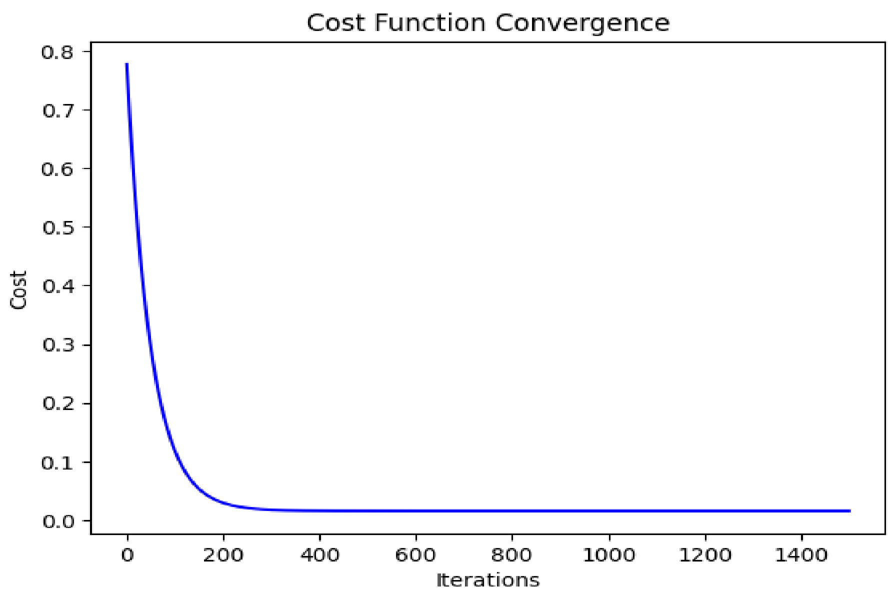
4.4.1 Visualizing Cost Function J(θ)

- This is a 3D representation of the cost function with a 3-dimensional grid of θ_0, θ_1, and $J(\theta)$ values. The red point in the plot represents the point where the cost function achieves its minimum value after applying the gradient descent algorithm.



4.4.2 Plotting the covergence

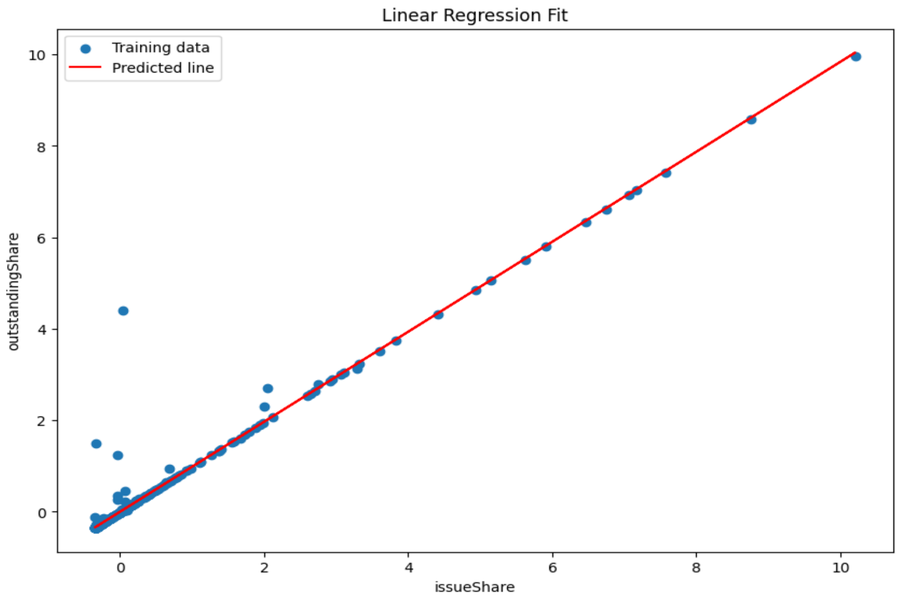
- This is a plot showing the convergence of the cost function.



4.5 Training Data with Univariate Linear Regression Fit (Best Fit Line)

4.5.1 Linear Regression Fit

- This is the optimal regression line through the training data.



4.5.2 Model Evaluation

- MAPE evaluates the average percentage deviation of predictions from actual values.

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{y_{true,i}}{-}y_{pred},iy_{true,i}\right| \times 100$$

- In which:

$y_{true,i}$ is the true value of sample i.
$y_{pred,i}$ is the predicted value of sample i.
n is the number of samples.

- Applying MAPE to the linear regression model, MAPE = 4.65% means that the model's predictions deviate by approximately 4.65% from the actual values on the test data.

5. Conclusion

- Through this exercise, we have learned how to implement a linear regression model in practice. This helps us gain a deeper understanding of the linear regression model.