01/04/'25

REGULARIZATION

Modelling :- ($R^2 \rightarrow 0.8$)

0.7
0.88

01/04/25

Metrics (Error)

Train error 27%

Overfitting

Test error 25%

mape (y_train, train_pred)

mape (y_test, test_pred)

m = LR()

m.fit(x_train, x_test)

m.predict (x_train) → Train

= m.predict (x_test) → Test

(train_pred) —

(test_pred) —

train_test_split(X, y, test_size = 0.3, random_state = 0)

70%   30%

Underfitting:
- train 45% mape
- test 50% mape

X

Regularization : X

- L1 (LASSO)
- L2 (Ridge)
- Elastic Net (Lasso + Ridge)

LASSO:

Objective? Reduce the error

$3 \rightarrow i/p$

$$\boxed{\lambda = 1}$$

Error = $y - \hat{y}$

$$E = \sum y - (mx_1 + b) + \lambda \sum \left|(m_1 + m_2 + \dots m_n)\right|$$

$$= \sum (y - (m_1x_1 + m_2x_2 + m_3x_3 + b)) + \lambda \sum \left|(m + m_2 + m_3)\right|$$

$=$

Regularization →

- It will try to penalize the large coefficient variables
- It will lead to coefficient shrinkage
- It gives room to learn the hidden patterns from other variables also

(4 var)

Price → Target

i/p → size (X_1) #, yearbuilt (X_2) #, neighbor (X_3) #, proximity (X_4) #

= X' × 20000 → i/p

$1M ⟷ $250k

(0–5) 2000 mi

m_1 → Large

m_2 → very small

m_3 → "

m_4 → "

$$\text{Price} = m_1 x_1 + m_2 x_2 + m_3 x_3 + m_4 x_4 + m_0$$

m_1

$(17000) \times 2000 + 0.001 \times 12 + 0.25 \times 5$

0.1

0.25

+ 20 × 2.5

↓

45

15000

X_1 = Price

Train → ~~5%~~ (mape) | 15%

Test → 30% (mape) | 20%

Generalize →

Error: (LASSO)

$\boxed{\lambda = 1}$

$m_1 \Rightarrow 20$

$m_2 \Rightarrow 0.25$

$\boxed{MSE}$

$$\hookrightarrow \underbrace{\sum \frac{\left(y - (mx+b)\right)}{n}} + \lambda \sum \left| (m_1 + m_2) \right|$$

$\boxed{\lambda = 0}$? $\boxed{\lambda = 1 \text{ to } \infty}$

Linear Regression

$$\boxed{MSE} = 2500 + \underbrace{1 \left| (20.25) \right|}_{\text{penalty}} = 2520.25$$

$2500 \rightarrow = 2502.61$

Sum of squared + Sum of Absolute of coeff

error

2%

Train Err → 10%

10 – 15

Very less variance

Test Err → 17

17 – 20%

Shrinkage

$X_1 \to m_1 \to$

$X_1 \to m_1 \to 100$

$\downarrow$

$m_2 - 75$ (80)

50

25

LR → m_1 → 175

LASS → m_1 → ~~158~~ 150

$\boxed{\lambda = 0.01}$ → 100

$\boxed{\lambda = 10}$

100

1000

150

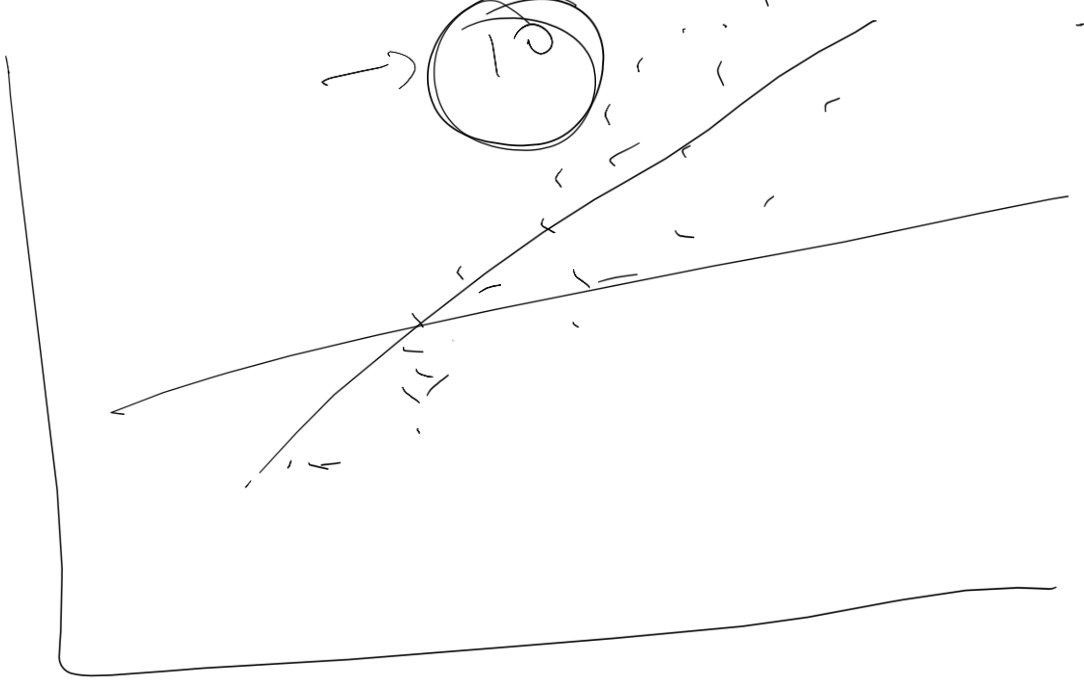
Train = 15

Test = 17

$M_2 \rightarrow 30$

$\rightarrow 10$

price



size

$M_3 \rightarrow 50$

$\rightarrow 5$

$M_1 \rightarrow 175$?

$M_2 \rightarrow 25$

model. coeff

Underfitting

Grad = Error = ↓

Error = ↑

Ridge : Never make coeff to 0 $\lambda \in 1$ to ∞

$$Error = \sum y - (mx + b) + \lambda \sum (m_1^2 + m_2^2 + \dots m_n^2)$$

$\boxed{\text{House\_color}}$ $\longrightarrow$ $\boxed{\text{Coeff} \to 0}$ (LASSO)

(X_3)

(Variable Selection)

$$m_1 x_1 + m_2 x_2 + \boxed{m_3 x_3} + b_0$$

$$0 \times 2$$

Ridge: [Coeff ≠ 0]

Sum of Square of errors + Sum of Square of coeff

3-variable coeff
1-var

Elastic Net: $\boxed{\text{LASSO}}$ $\boxed{\text{Ridge}}$

$$y - (mx + b) + \lambda \sum |m_1 + m_2| + \lambda \sum (m^2 + m^2)$$

0.5   0.1   0.5   0.25

Mobl Luxury_Level (1)	Model (1)	(LE)
3	AUDI	3
3	BMW	
3	Cadillac	
	Ford	
2	Kia	2
2	Mazda	
1	Mustang	1
2	Camaro	

Vehicle class (:1) $\boxed{\text{OHE}}$

	VC_Compact	VC_SUV	VC_Sedan	VC_m
Compact	1	0	0	0
Midsize	0	0	0	1
SUV				
Sedan	0	0	1	0