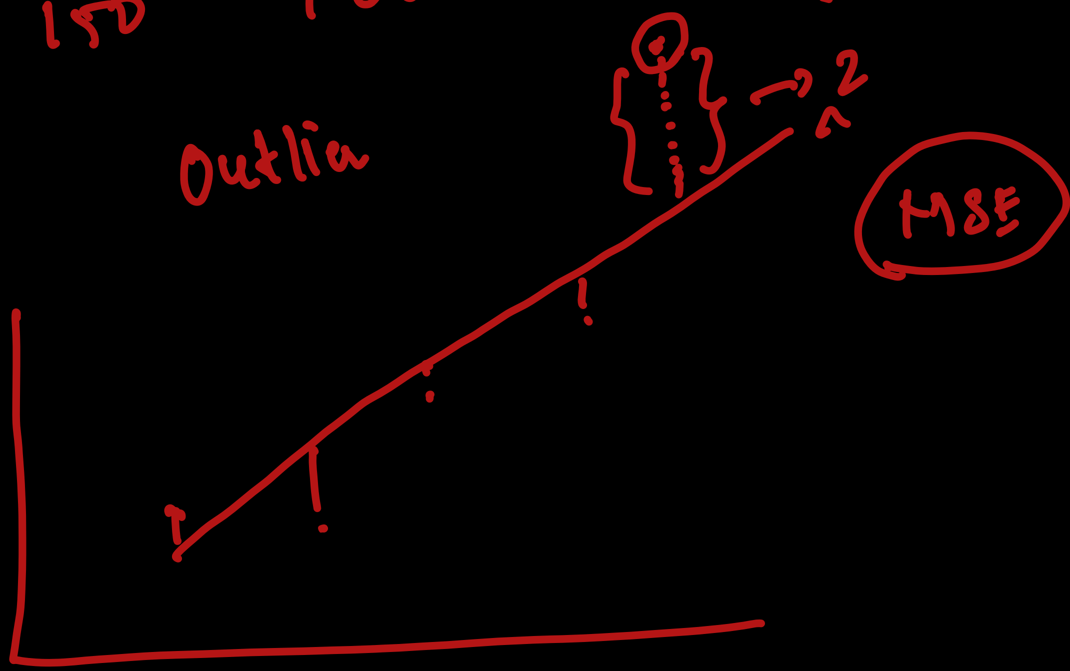
House	Price	$\hat{y}$	error	MAE Absolute E	MSE E^2
1	250	245	5	5	25
2	300	315	-15	15	225
3	180	175	5	5	25
4	420	390	30	30	900
5	150	165	-15	15	225



MAE
↓
$\boxed{\$14000}$ ⇒ we are off by 14k on average

Treats the small and large error equally

In reality 30k error more problematic than 5k error

MSE

MSE

Error 250,000

Stock price prediction

Sensitive to outlier

$5 → $2 ⟷ 3 $

$50 → $2 ⟷ 48 $ ←

RMSE

$= \sqrt{MSE} \Longleftrightarrow MAE$

RMSE ≈ MAE → error are Consistent

RMSE >> MAE → large error

16K 14K

Error ↓ → Constraint

Find m and b → Goal

m ↓ slope

b ↓ intercep

$$\text{Error} = y - \hat{y}$$

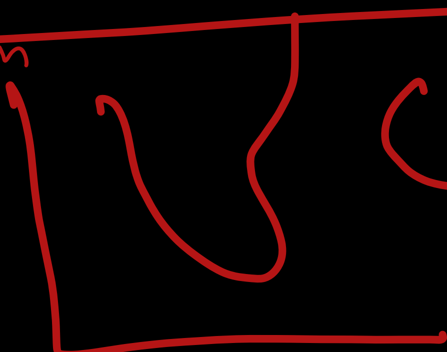
$$\underline{MSE} = \frac{\Sigma (y - \hat{y})^2}{n}$$

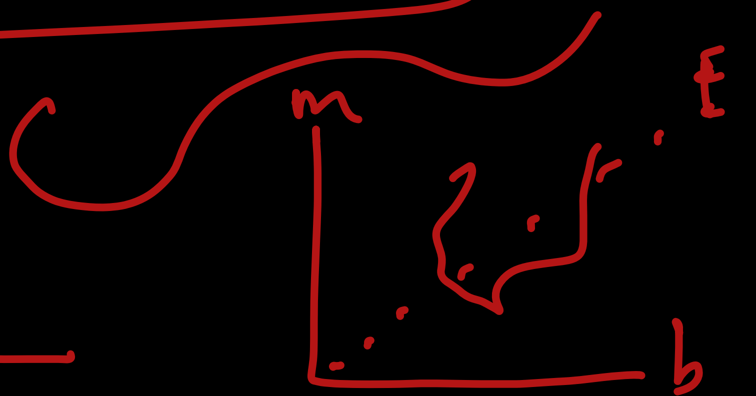
$$MSE \downarrow = \frac{\Sigma (y - (mx + b))^2}{n}$$

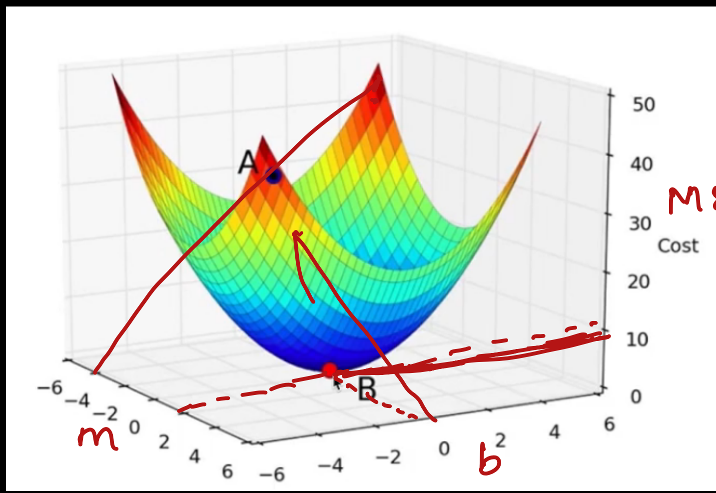
loss function

cost function

Find m and b







actual term
input

$$MSE = \frac{\sum (y - (mx + b))^2}{n}$$

constant

$$y = 4x^2 + 2x$$

$$\frac{dy}{dx} = 8x + 2$$

2 Variable
- m
- b

Derivate $\xrightarrow{\text{more than one variable}}$ Partial Derivate

$$y = 2x^2 + \underline{2z} + 2$$

$$\frac{\partial}{\partial x} = 4x + 0 + 0$$

$$\frac{\partial}{\partial z} = 0 + 2 + 0$$

whenever you do a partial derivate just focus on which variable you are derivating

other variable what ever you see treat it as constant

MSE

- $m \rightarrow \frac{\partial}{\partial m} \rightarrow b$
- $b \rightarrow \frac{\partial}{\partial b} \rightarrow m$

$$MSE = \sum \frac{(y-\hat{y})^2}{n}$$

$$= \frac{\sum (y - (mx+b))^2}{n}$$

$(a+b)^2 = a^2+b^2+2ab$
$(a-b)^2 = a^2+b^2-2ab$

$$= \frac{1}{n}\sum (y^2 + (mx+b)^2 - 2y(mx+b))$$

$$MSE = \frac{1}{n}\sum y^2 + m^2x^2 + b^2 + 2mxb - 2ymx - 2yb$$

$$\frac{\partial}{\partial m} = \frac{1}{n}\sum 0 + 2mx^2 + 0 + 2xb - 2yx - 0$$

$$\frac{\partial}{\partial m} = \frac{1}{n}\sum 2mx^2 + 2xb - 2yx$$

$$= \frac{2}{N}\sum mx^2 + xb - yx$$

$$= \frac{2}{N}\sum x(mx+b-y)$$

$$\boxed{\frac{\partial}{\partial m} = \frac{2}{N}\sum -x(y-(mx+b))}$$

m-gradient

$b' \Rightarrow 1 b^0$

$$MSE = \frac{1}{n}\sum y^2 + m^2x^2 + b^2 + 2mxb - 2ymx - 2yb$$

$$\frac{\partial}{\partial b} = \frac{1}{n}\sum 0 + 0 + 2b + 2mx - 0 - 2y$$

$$\frac{1}{n}\sum 2b + 2mx - 2y$$

$$\boxed{\frac{2}{n}\sum b + mx - y}$$

$$\boxed{\frac{\partial}{\partial b} = \frac{2}{n}\sum -(y - (mx + b))}$$

b-gradient