

~~Agenda:~~

Linear Regression

↳ assumptions (VIF) → remedial

→ Underfitting & overfitting

↳ Bias-variance tradeoff

{
 ↳ Concept; Math; intuition
 ↳ Code&viz

statistician
prob & stats
Assumptions

Lr. Reg

✓ Assumptions
Underlying
Lr. Reg

algebra & optimization
(geometric) ✓

Modern ML

①

linearity:

$\exists f_{\text{linear}}$

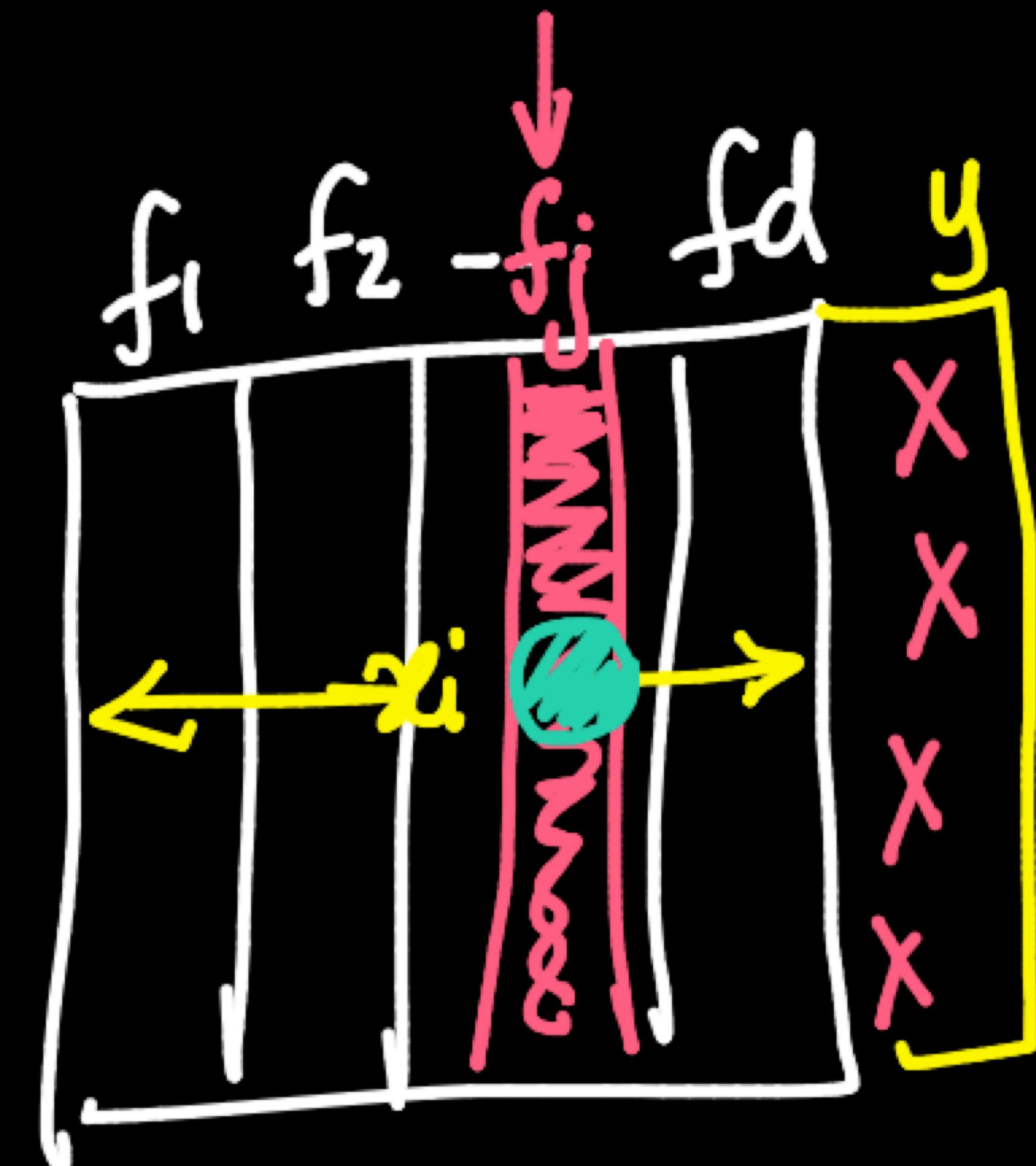
$$y_i = f_{\text{linear}}(x_i)$$

\downarrow
 $d\text{-dim}$

②

Features are not ~~highly-correlated~~

(Multi-collinear) \checkmark



$$i : l \rightarrow n$$

$$j : l \rightarrow d$$

$$x_{ij} = d_0 + d_1 \tilde{x}_{i1} + d_2 \tilde{x}_{i2} + \dots + d_{j-1} \tilde{x}_{i,j-1} + d_j x_{ij} + t \dots$$

$f_j \leftarrow \underline{g_{\text{linear}}}$ (all other features
except j^{th} features)

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

GEOMRTT

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Srikanth Varma Chekuri (You) (Screen)

00:14:36

✓ $\hat{y}_i = \underline{f_{\text{linear}}(x_i)}$

$\left\{ \begin{array}{l} \hat{y}_i \approx y_i \\ \epsilon_i \end{array} \right.$

00

Srikanth Varma Chekuri (You)

Chat

Notify me about Nothing

Pin a message + 9:07 pm

6

Sabuj Chattopadhyay To: Everyone 9:08 pm

How can you apriori know whether such function exists or not?

Sri Ramya To: Everyone 9:09 pm

I have one doubt in linearity 2 New Messages

Start Doubt Session

To: Everyone Enable/Disable Chat

Type message

50 People

Chat

Questions

6 / 6

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DSML Advanced : Bias-Varianc...

DSML Advanced : Bias-Varianc...

50 People

Chat

Questions

Start Doubt Session

00:15:54

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$f_j \approx \log(f_i)$

| f_i | f_i |

Srikanth Varma Chekuri (You)

Chat

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Sabuj Chattopadhyay To: Everyone 9:08 pm

Pin a message

Sri Ramya To: Everyone 9:09 pm

I have one doubt in linearity

Muthu kamalan To: Everyone 9:09 pm

can we say independent of each other??

Sabuj Chattopadhyay To: Everyone 9:12 pm

1 New Message

jth column is a linear combination of all

Yes No

To: Everyone Enable/Disable Chat

Type message

7 / 7

GEOMRTT

Scalera

MC for categorical-var one-hot-variables

	c_1	c_2	c_3
1	1	0	0
0	0	1	0
0	0	0	1

$$\{ \alpha c_1 + \beta c_2 + \gamma c_3 \}_{l=0}$$

Theory vs practice

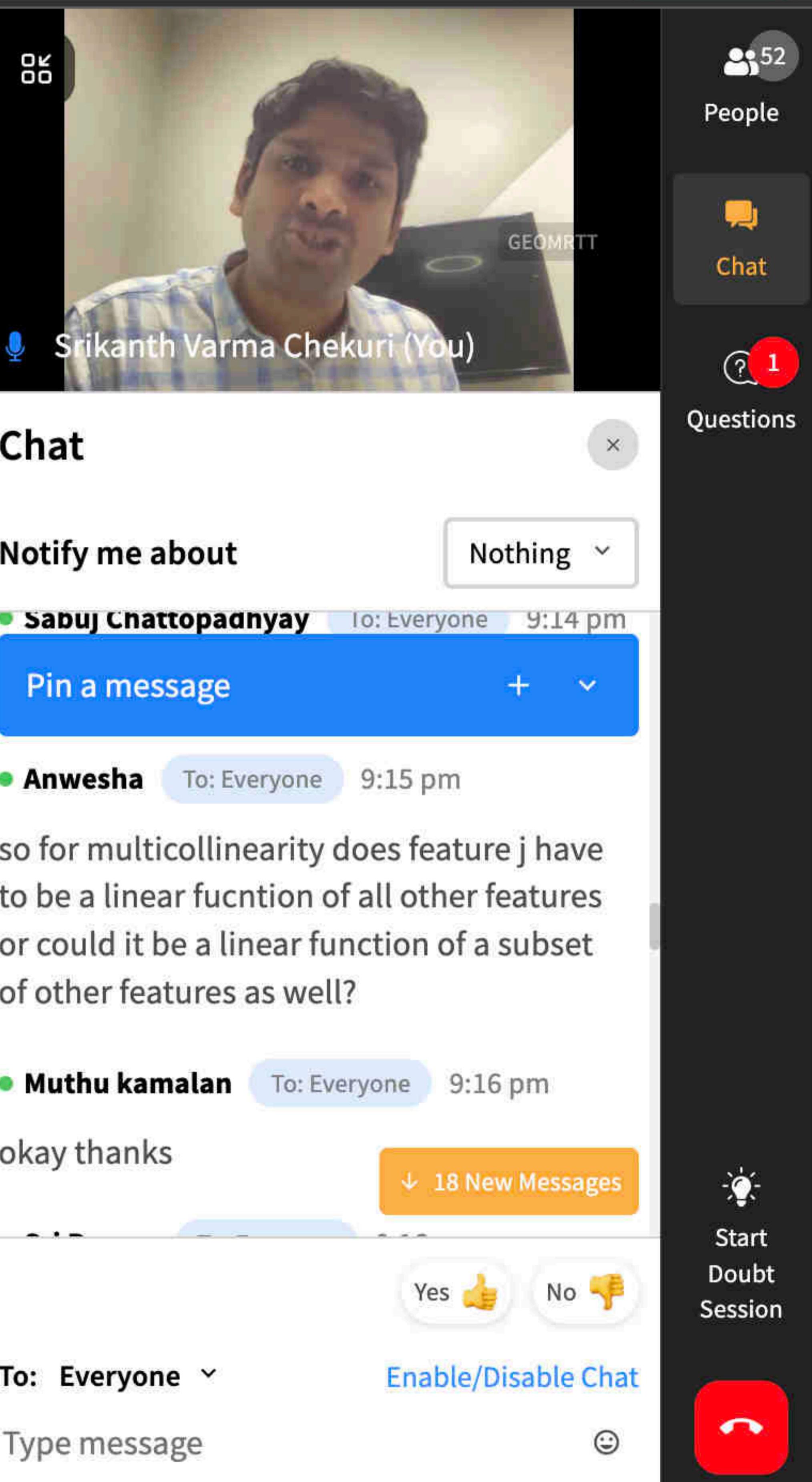
mean/median encoding
Stats ↑

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Underfitting-Overfitting.ipynb x +

← → ⌂ scaler.com/meetings/i/dsml-advanced-bias-variance-regularisation-cross-validation-2/live



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فارسی

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Nederlands

Português

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文 A 14 more

Edit links

5 Inference

- 5.1 Using a permutation test
- 5.2 Using a bootstrap
- 5.3 Standard error
- 5.4 Testing using Student's t -distribution
- 5.5 Using the exact distribution
 - 5.5.1 Using the exact confidence distribution

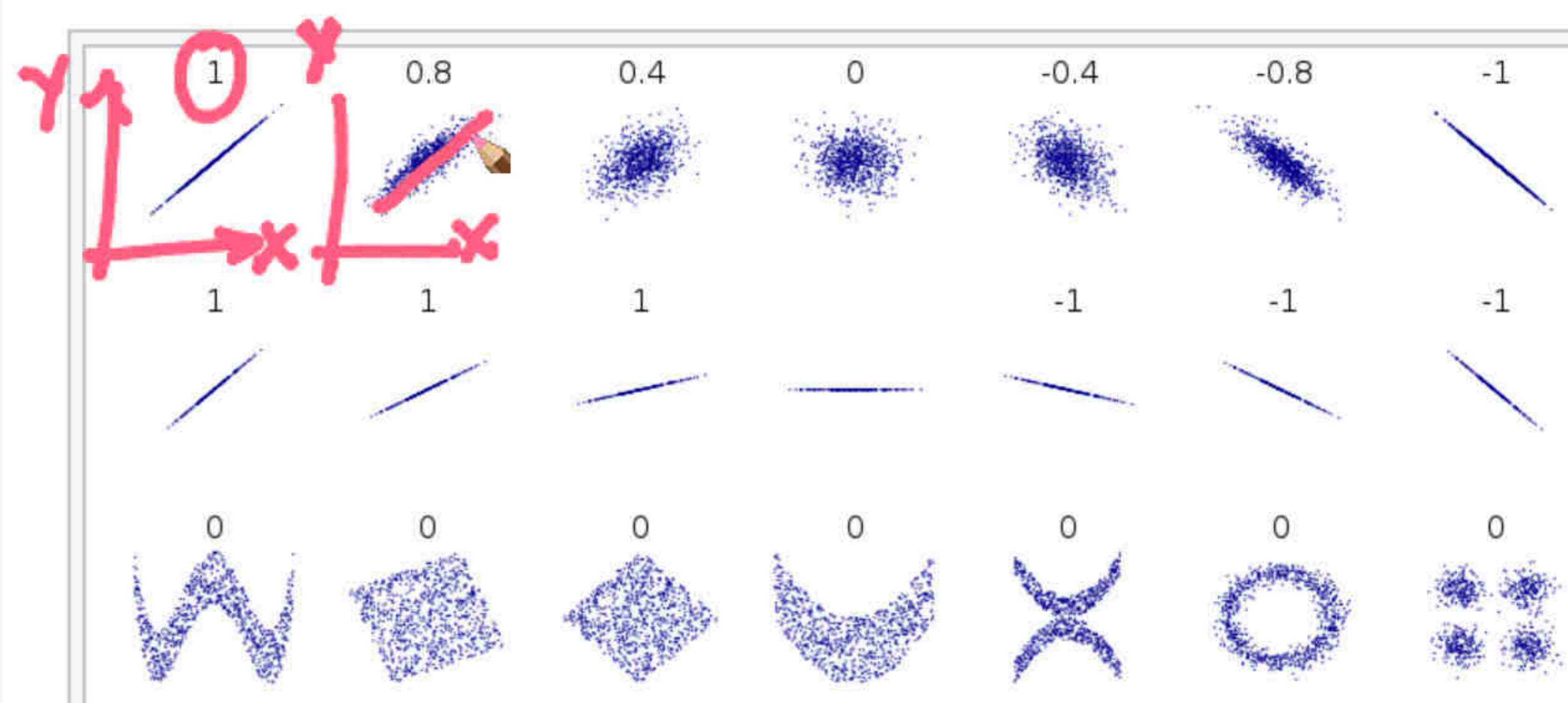
5.6 Using the Fisher transformation

6 In least squares regression analysis

7 Sensitivity to the data distribution

7.1 Existence

7.2 Sample size

coefficient (ρ)

Several sets of (x, y) points, with the correlation coefficient of x and y for each set. Note that the correlation reflects the strength and direction of a linear relationship (top row), but not the slope of that relationship (middle), nor many aspects of nonlinear relationships (bottom). N.B.: the figure in the center has a slope of 0 but in that case the correlation coefficient is undefined because the variance of Y is zero.

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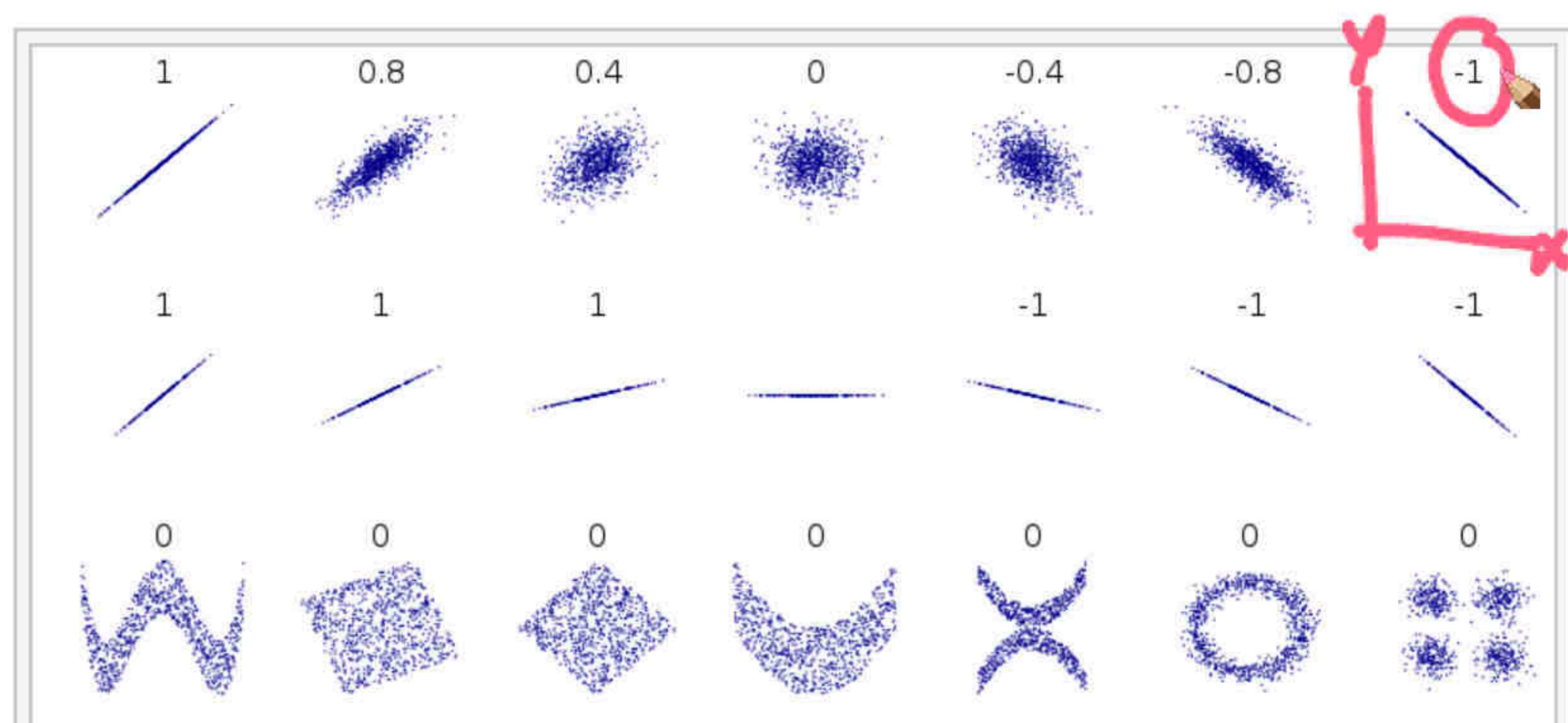
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Live | DSML Advanced : Bias

Underfitting-Overfitting.ipynb

Pearson correlation coefficient

en.wikipedia.org/wiki/Pearson_correlation_coefficient

Update

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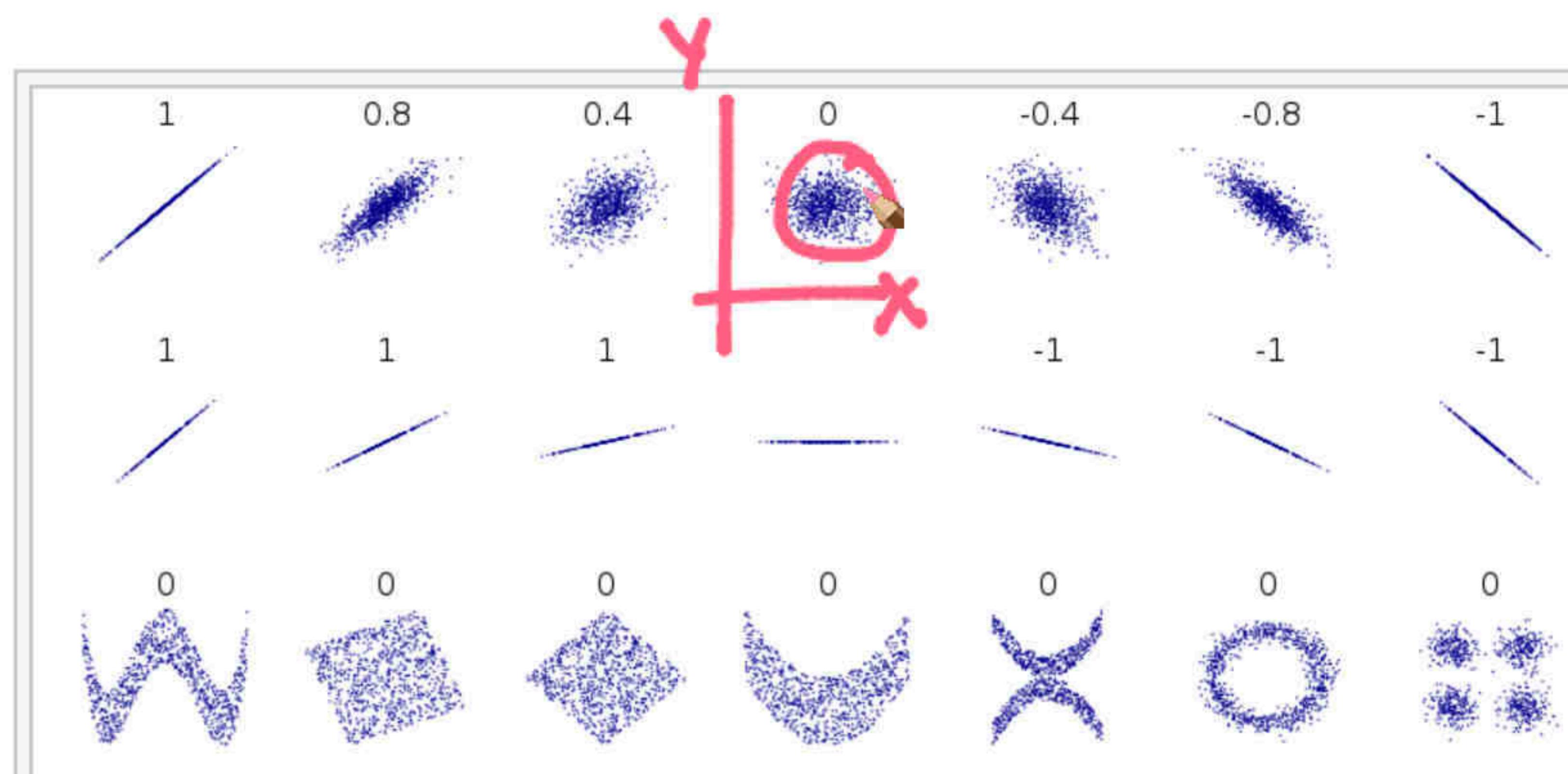
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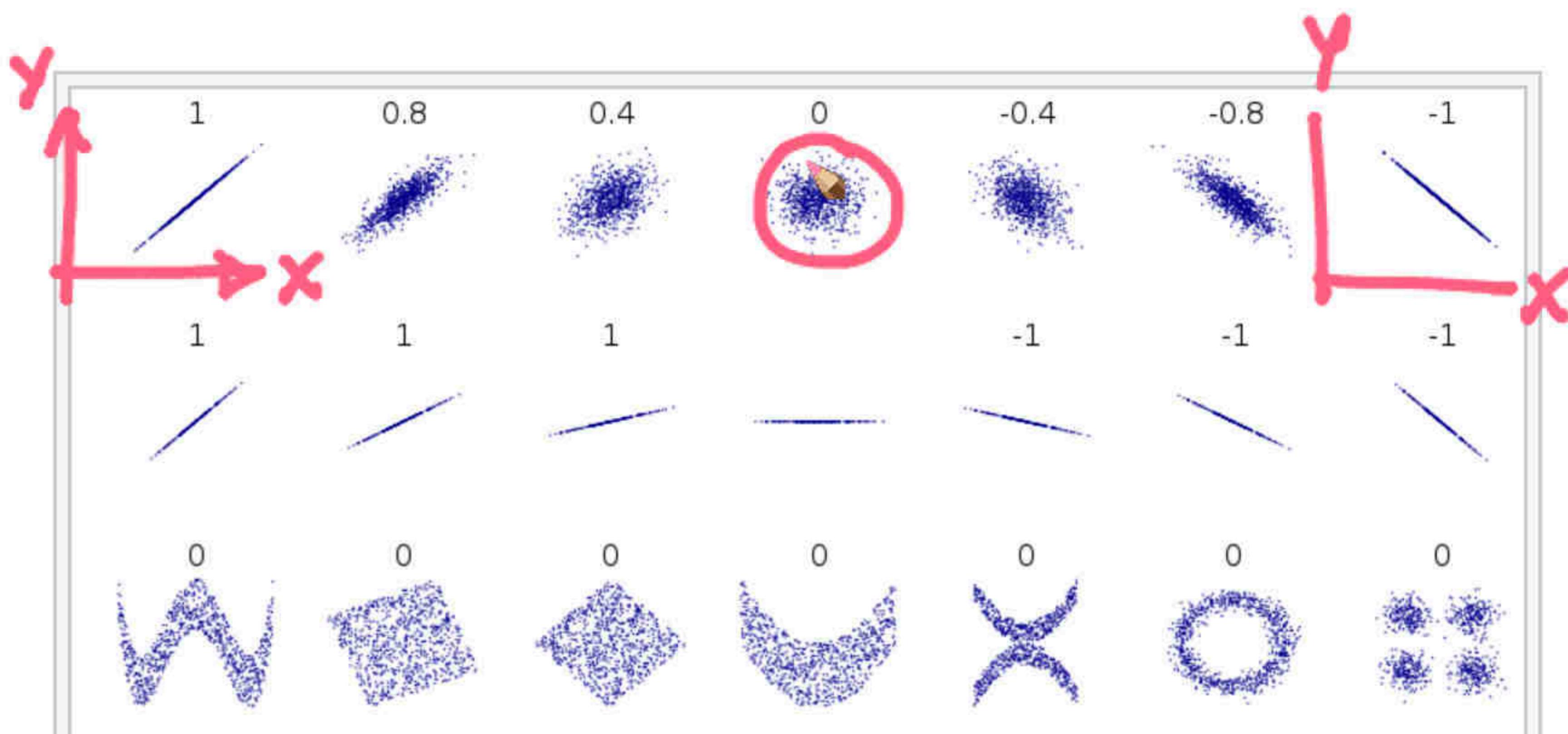
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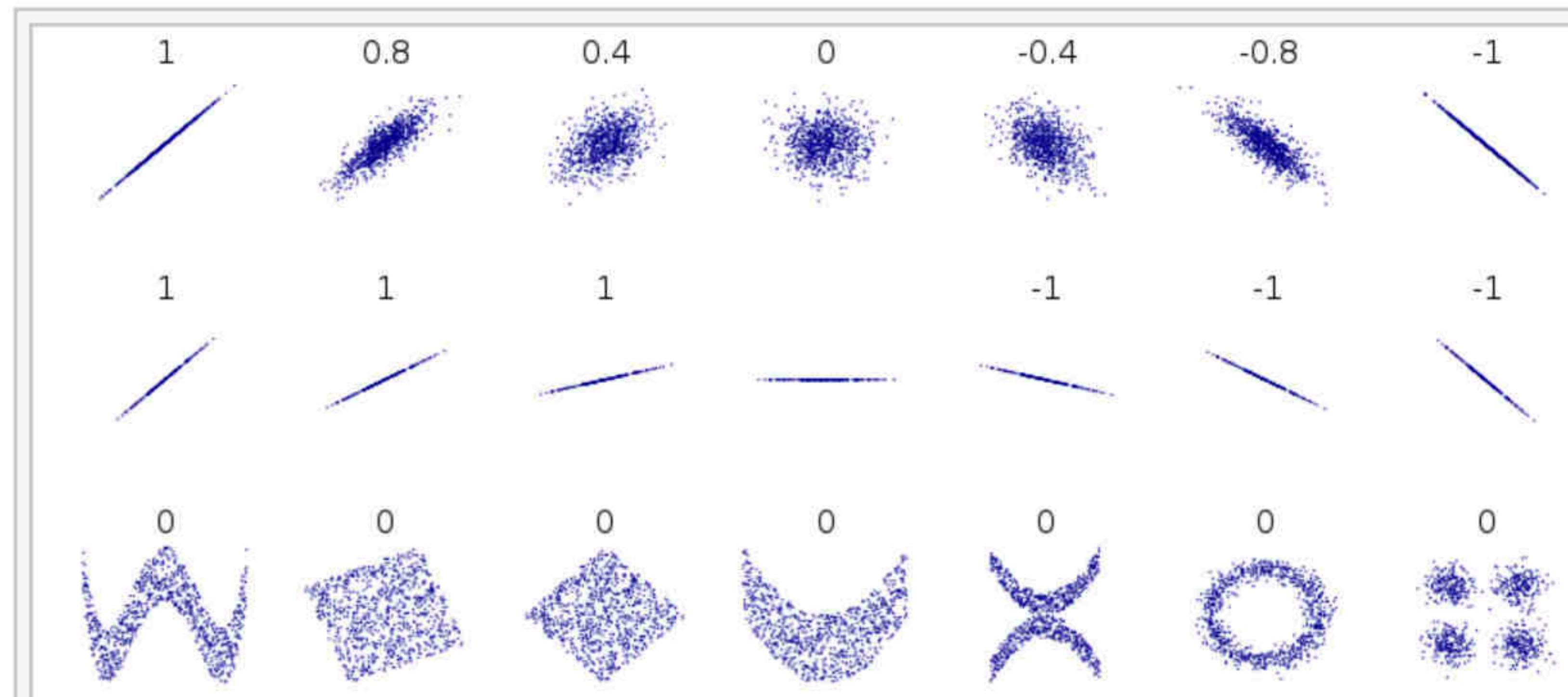
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MC: $f_j \leftarrow \text{all other features}$ (all other)

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GEOMRTT

Srikanth Varma Chekuri (You) (Screen)

00:28:06

00:00

15 / 16

Srikanth Varma Chekuri (You)

Chat

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Multicollinearity ::

Saurabh Bhondekar To: Everyone 9:18 pm

Do all var have to have linear relationship with a particular var or just one var can also bring out multicollinearity ?

Saurabh Bhondekar

But doesn't KNN imputer uses other variables to impute missing values ? We

Yes No

To: Everyone Enable/Disable Chat

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Questions 1

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00:31:10

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Srikanth Varma Chekuri (You) (Screen)

00:31:10

$f_j \leftarrow \text{linear function of all other features}$

People 49

Chat

Questions 2

Srikanth Varma Chekuri (You)

Chat

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Chitwan Manchanda To: Everyone 9:28 pm
If there exists any other relationship between dependent variables which is not linear, then is it not MC?

Chitwan Manchanda To: Everyone 9:28 pm
confused here

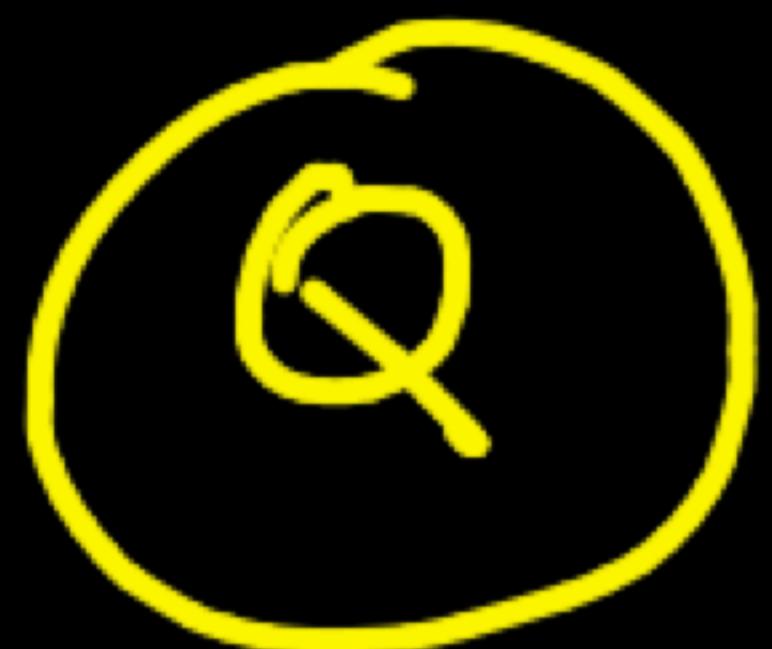
GEOMRTT Yes No

To: Everyone Enable/Disable Chat

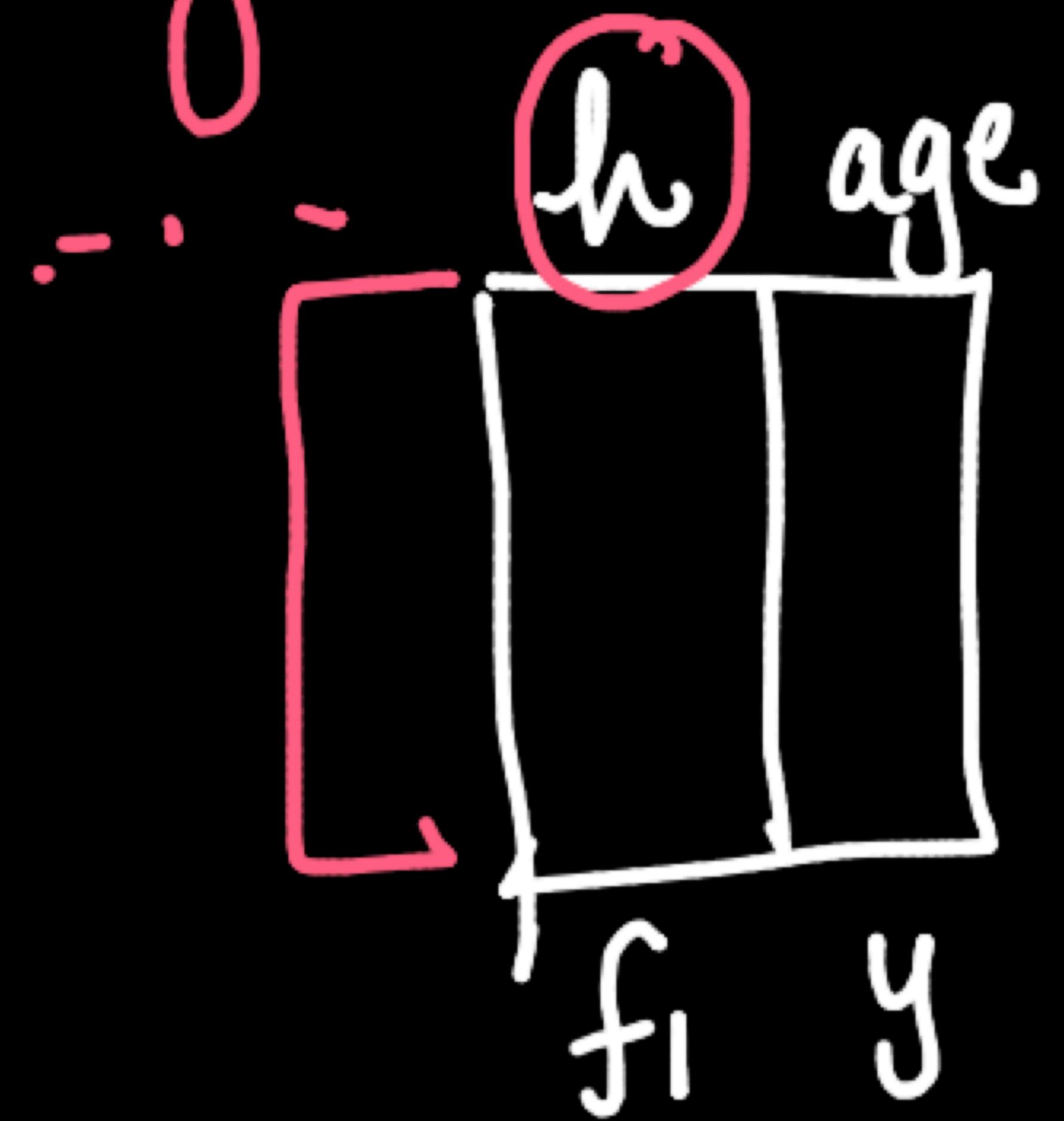
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Start Doubt Session

16 / 16



Why is MC a problem?



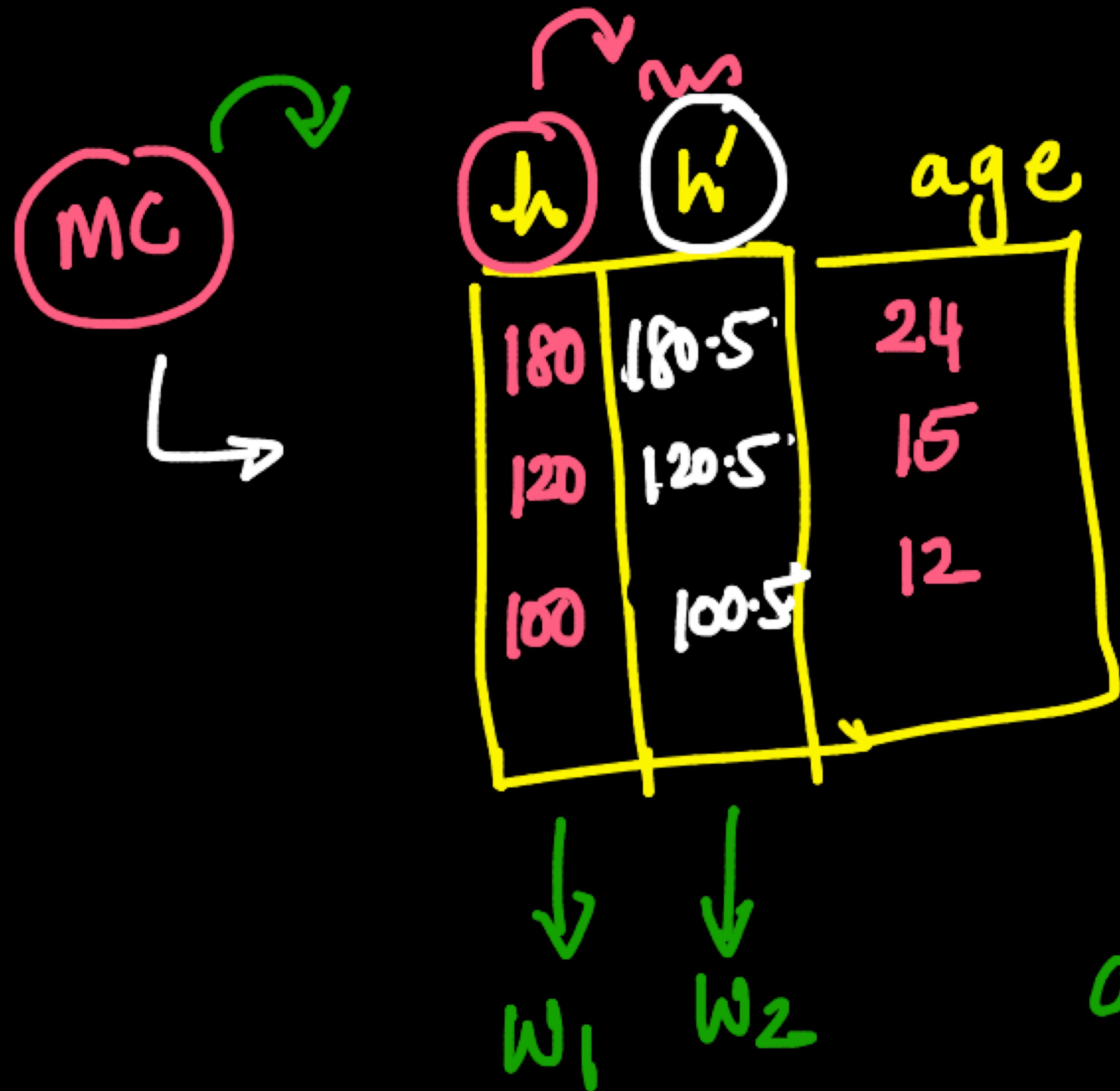
$$y = \text{age} = w_1 \times h + w_0 \rightarrow \dots$$

feat. imp
Interpretability

+ve, 0, -ve

4 (let)

The equation $y = \text{age} = w_1 \times h + w_0 \rightarrow \dots$ is shown with a yellow box highlighting the term $w_1 \times h$. An arrow points from this term to a circled number '4' with the label '(let)'. Another arrow points from the circled '4' to the word 'feat. imp'. Below this, another arrow points down to the word 'Interpretability'.



$$h' = f \times h + 0.5$$

$h \text{ vs } h'$: linear rel

$age = w_1 h + w_2 h + w_0$

↑

messing up the weights



if MG → weights messes up

↓
can't do feat. imp

↓ ~
model interp is mess
✓ = up

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MC

Feat. Imp

overfitting (later)

pred'clim

time

mess-up

Srikanth Varma Chekuri (You)

Chat

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prediction? 9:39 pm

Akshat To: Everyone 9:40 pm

In MC - However, if both variables serve different purposes, then having equal weight makes sense

Start Doubt Session

00:41:37

21 / 21

People 49

Chat 2

Questions

Yes No

To: Everyone Enable/Disable Chat

Type message

Update



VIF:

$$f_1 f_2 \dots f_j \dots f_d$$

↳ d-linear regression $\rightarrow 0 - 1$

- $f_1 \xleftarrow{\text{ly}} \text{all other feat} \rightarrow R_1^2$
- $f_2 \xleftarrow{\text{ly}} \text{all other feat}$
- $f_j \xleftarrow{\text{ly}} \text{all other feat} \rightarrow R_j^2$

$$VIF_j = \frac{1}{1-R_j^2}$$

best: $R_j^2 \approx 1 \Rightarrow f_j = Lx \cdot \text{model}$
(other feat)

$VIF_j \rightarrow \infty$

$$VIF_j = \frac{1}{1 - R_j^2}$$

mean-model $R_j^2 = 0 \Rightarrow f_j \notin Lr(\text{all other features})$
 $\Rightarrow VIF_j = 1$

$$\uparrow VIF_j \Rightarrow f_j = \text{lr(all other features)} \uparrow$$

\equiv

Rule of thumb

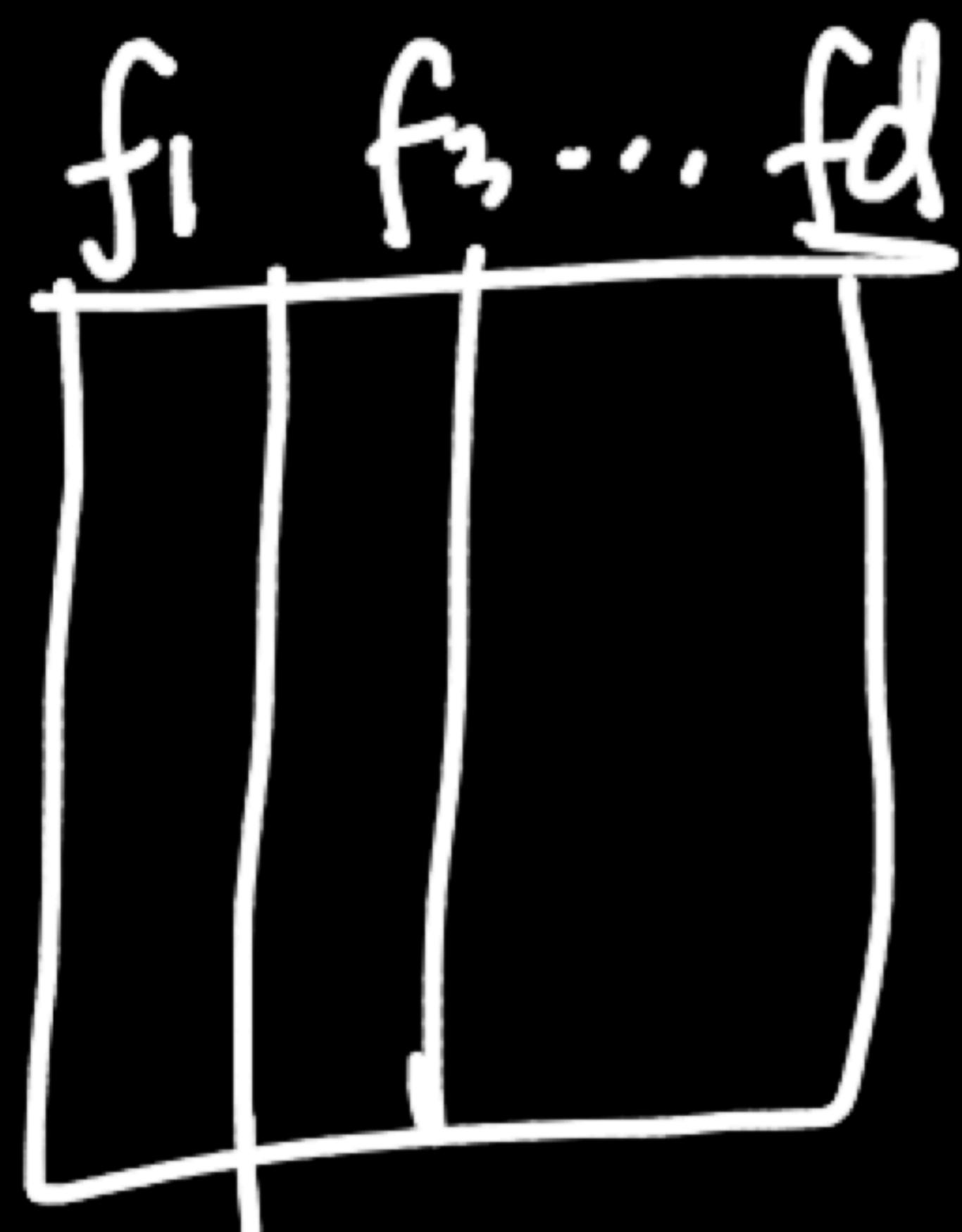
$$\begin{cases} VIF_j > 10 : \text{very high MC} \\ VIF_j \geq 5 : \text{high} \end{cases}$$

VIF \rightarrow d-features

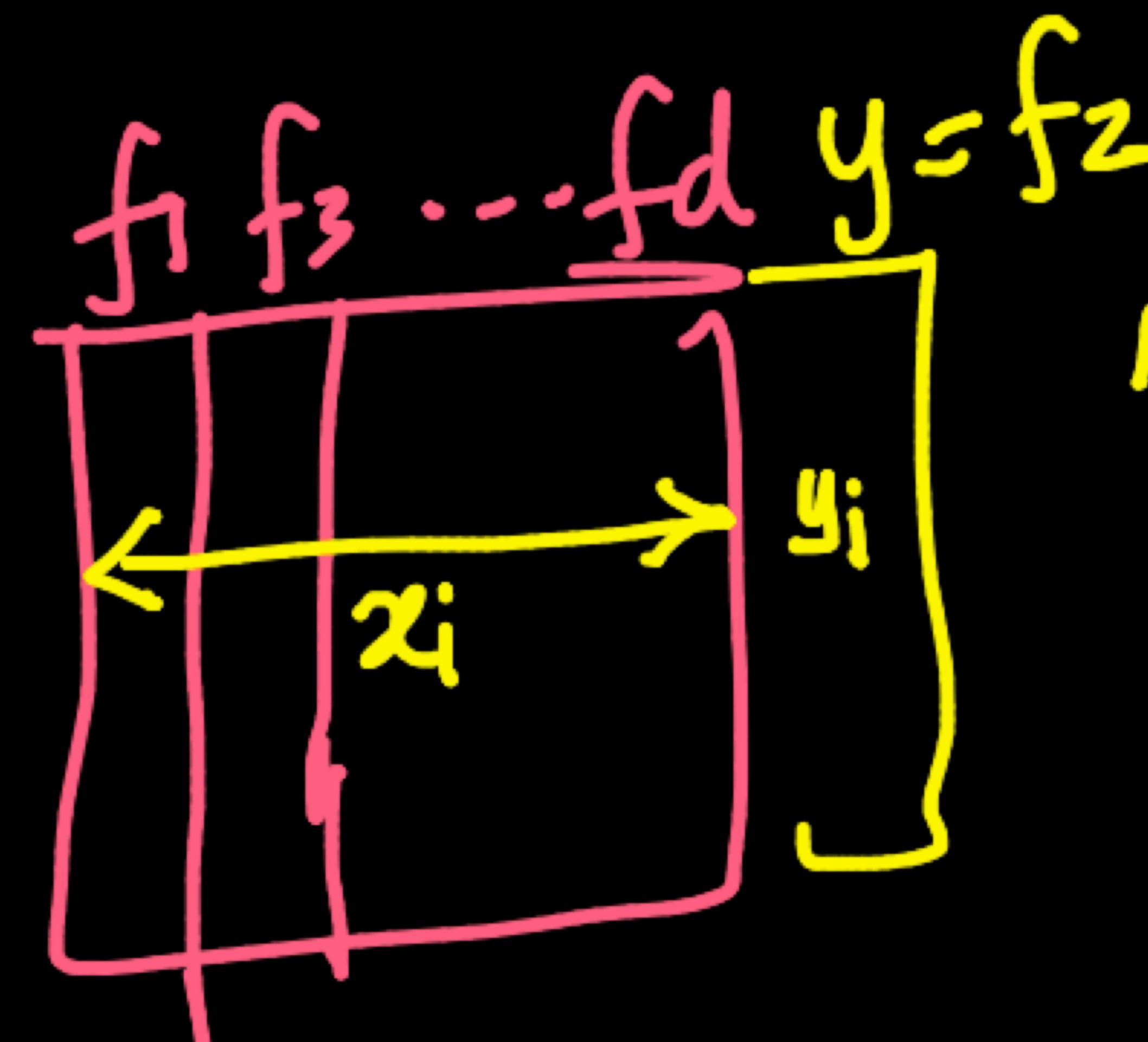


d-linear models

(time-taking)



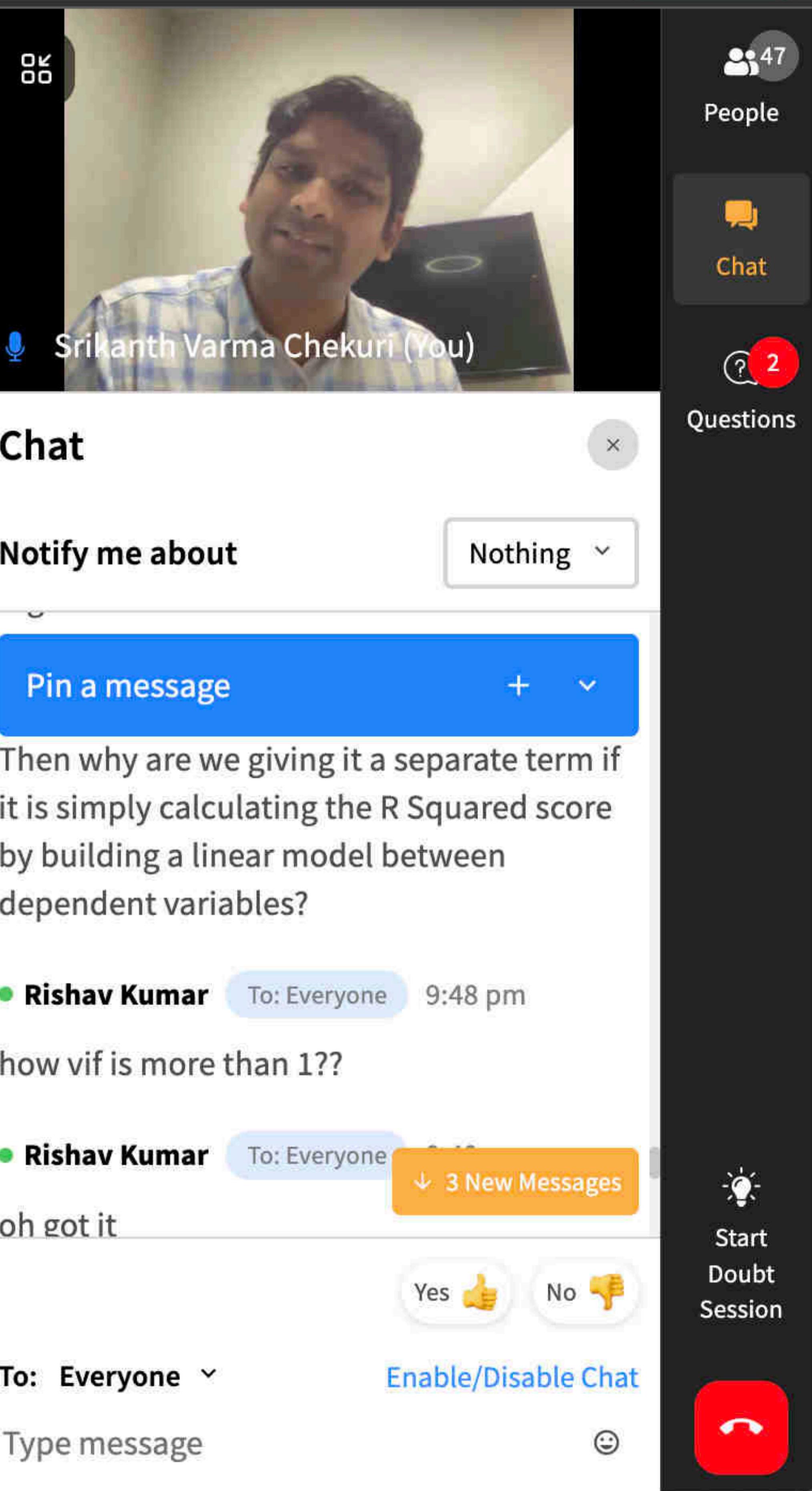
$f_2 \leftarrow \text{lr_model}(\text{all other featt})$



$$y_i = \underline{\omega^T x_i + \omega_0}$$

$d-1 \text{ dim}$

GD & opt



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$f_i = \alpha_i f_j + \alpha_0$

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Srikanth Varma Chekuri (You) (Screen)

00:53:51

00:53:51

88% 29 / 29

Srikanth Varma Chekuri (You)

Chat

Notify me about Nothing

Sabui Chattonadhyay To: Everyone 9:50 pm Pin a message +

Sumit Khajanchi To: Everyone 9:50 pm if 2 features are correlated, how do we decide which feature should be removed ?

karthik ponnappan To: Everyone 9:50 pm here we are trying to find a linear relation of j feature with all combination of other features or all the other features in a single go .. and find the VIF for each combination ?

Start Doubt Session

To: Everyone Enable/Disable Chat

Type message

People 47

Chat

Questions 2

Start Doubt Session

Yes No

Red button with white icon

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VIF_j : R_j²

f_j ← L_y(all other feat)

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Srikanth Varma Chekuri (You) (Screen)

00:55:21

00 00

Srikanth Varma Chekuri (You)

Chat

Notify me about Nothing

OK, got it. Thanks

Pin a message +

if 2 features are correlated, how do we decide which feature should be removed ?

karthik ponnappan To: Everyone 9:50 pm

here we are trying to find a linear relation of j feature with all combination of other features or all the other features in a single go .. and find the VIF for each combination ?

Sameer Udgirkar To: Everyone 9:51 pm

GEOMRTT
Yes No

To: Everyone Enable/Disable Chat

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Start Doubt Session

47 People

Chat

2 Questions

Start Doubt Session

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?

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MC

$f_j \leftarrow \text{lr-model}$
 other
 features

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00:58:51

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 / 31

80 00 Srikanth Varma Chekuri (You)

Chat

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Sumit Khajanchi To: Everyone 9:57 pm
And similar to my above question, if there are suppose 10 features and they are more or less related similarly to outcome, what should be our action in that case ?

Navroop To: Everyone 9:57 pm
what is the intuition behind this term "variance inflation" ? ↓ 1 New Message

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To: Everyone Enable/Disable Chat

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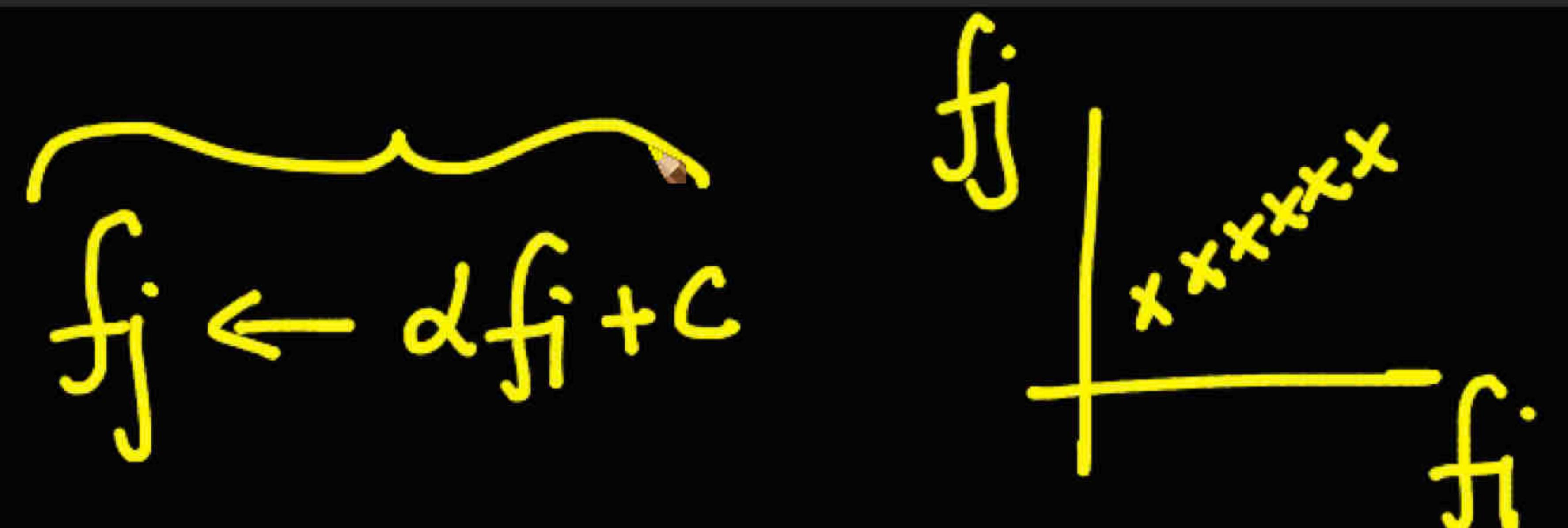
2 Questions

Start Doubt Session

Yes No

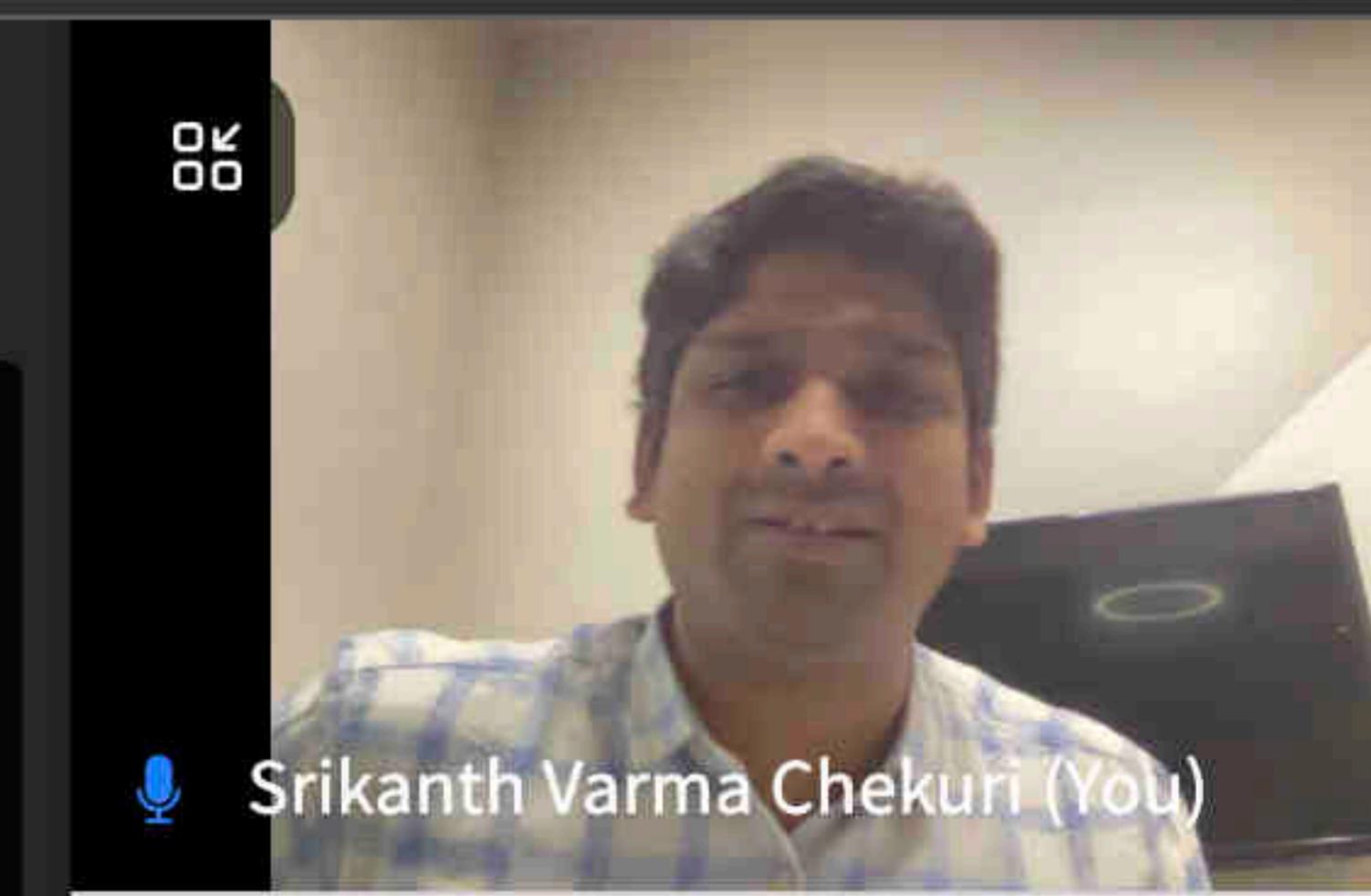
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Akshat To: Everyone 9:58 pm

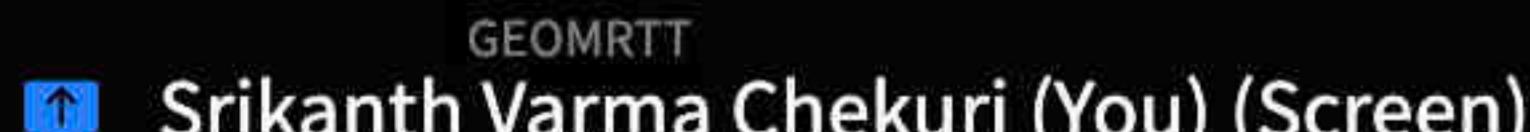
The two features should not be removed based on correlation (based on Heat map or pair plot). Feature should be removed only when it is linearly related to all other features using VIF score. (multi-collinearity).

Is this correct?

9:59 pm

Yes No

Enable/Disable Chat



01:00:57



Start

Doubt



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$f_j = \log(f_i)$

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f_i f_j

w_i w_j

Srikanth Varma Chekuri (You) (Screen)

01:06:11

00

46 People

Chat

3 Questions

Pin a message +

Sabuj Chattopadhyay To: Every... 10:04 pm

If any feature is even non-linearly related with other features, even then won't it have the effect of dilution of weights and its interpretation just like the way you said for multicollinearity

Sabuj Chattopadhyay To: Every... 10:06 pm

Yeah just wanted to clarify

GEOMRTT Yes No

To: Everyone Enable/Disable Chat

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Start Doubt Session

33 / 33

The image shows a video conference interface with a whiteboard overlay. On the whiteboard, there is a hand-drawn diagram illustrating a mathematical concept. The diagram features two vertical yellow lines labeled f_i and f_j . A pink arrow points from the top of the f_i line down to a label w_i . Another pink arrow points from the top of the f_j line down to a label w_j . To the left of the diagram, the text $f_j = \log(f_i)$ is written in large yellow letters. A blue button labeled 'Stop Sharing' is visible. A message at the bottom left of the whiteboard area says 'You are sharing your screen now'.

3

errors are normally disb

$$y_i - \hat{y}_i = e_i$$

$$\hat{y}_i = w_0 + w^T x_i + \epsilon$$

linear-model

$$N(0, \sigma)$$

{
stats } →
proof
or
derivation

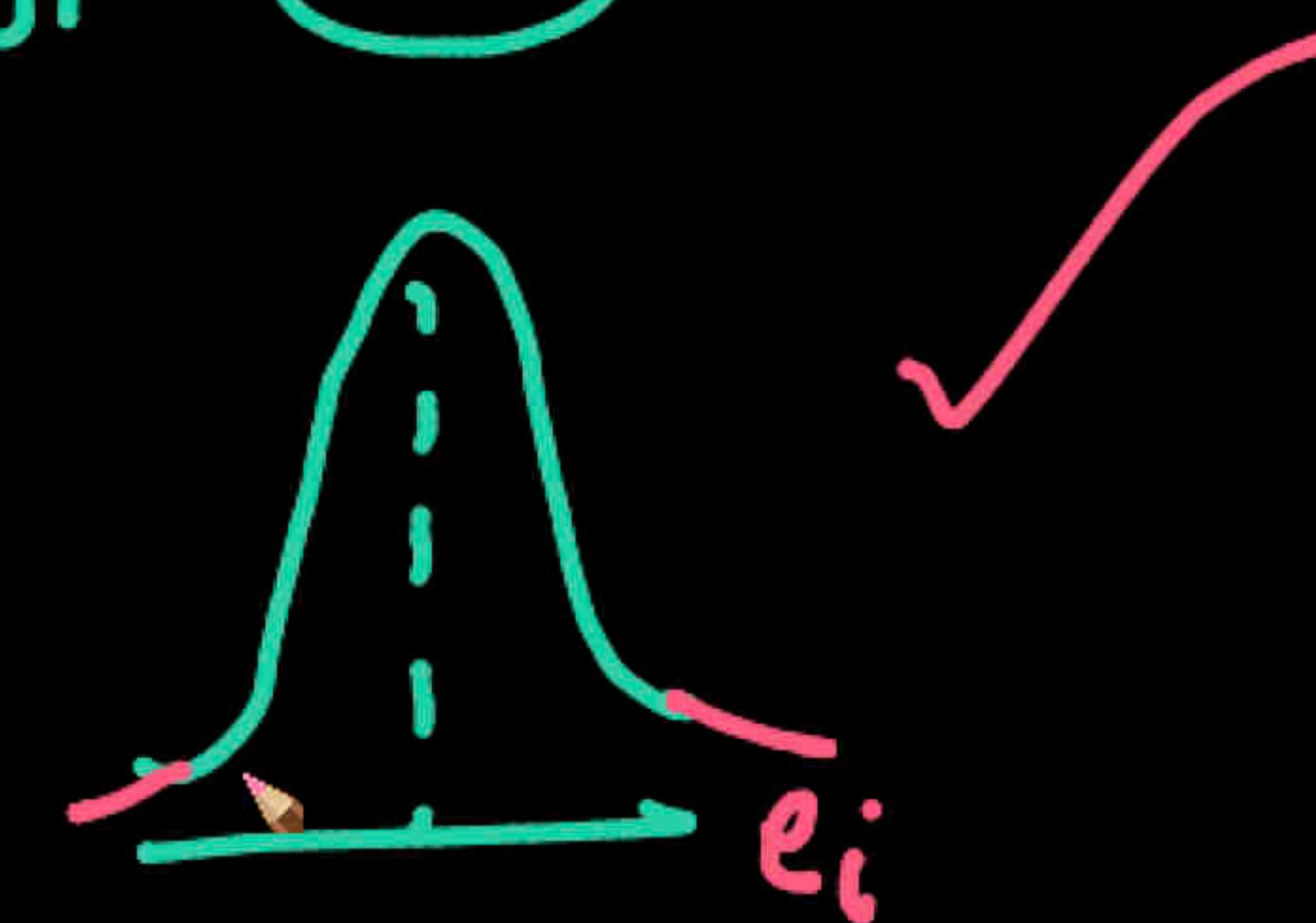
optimization problems

practice:

$$\hat{y}_i = f_L(x_i) = \omega^T x_i + w$$

$$y_i - \hat{y}_i = e_i$$

$i: l \rightarrow n$

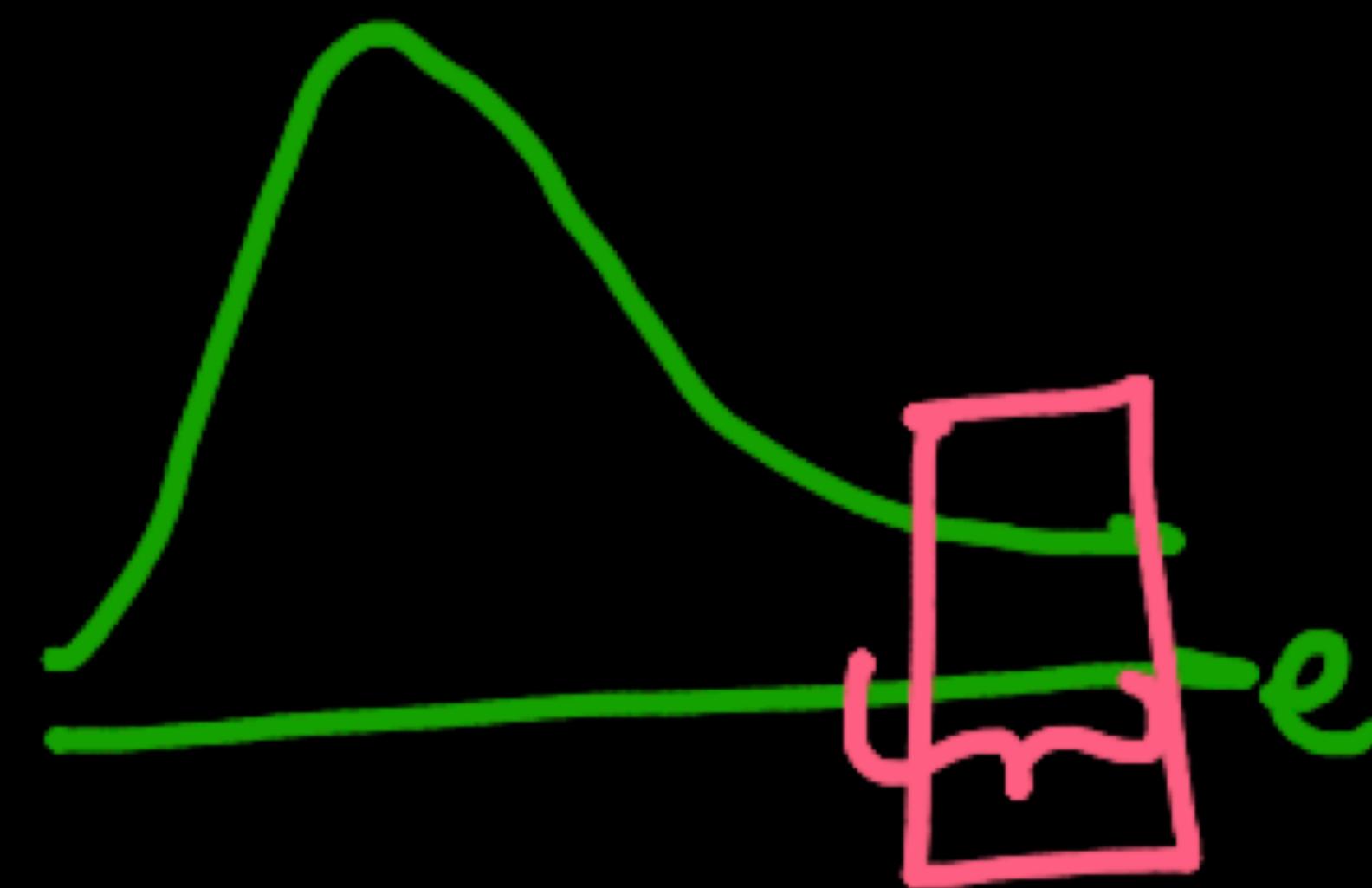


plot dist of e_i 's \rightarrow QQ plot or
KS-test or
AD-test

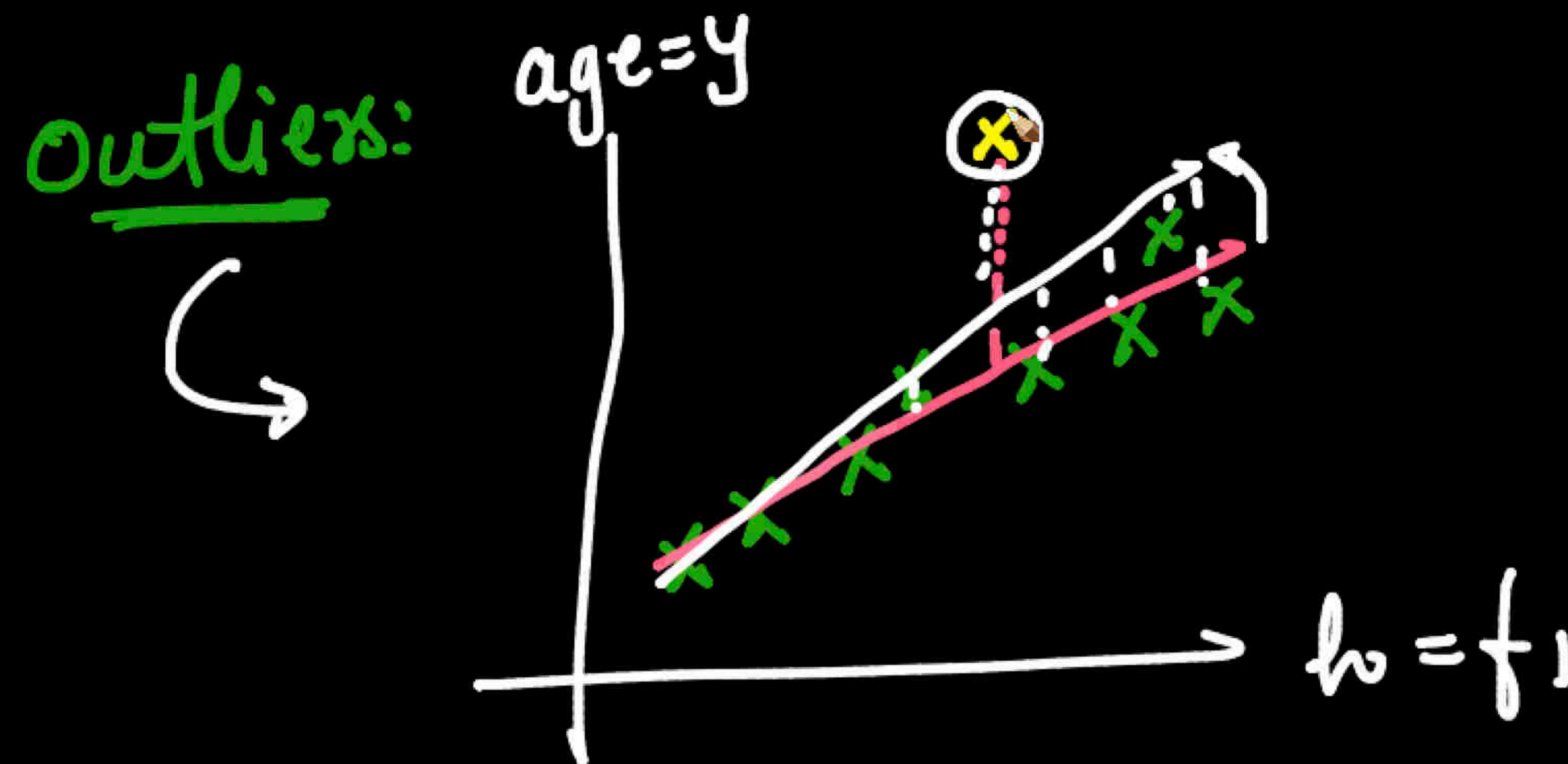
not-gaussian



{
outliers
==
are present



e_i 's are large



opt:

$$\sum_{i=1}^n (y_i - \hat{y}_i)^2$$

L-Square-loss

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$\frac{\text{Math work}}{\text{work}} \rightarrow e_i \sim N(0, \sigma)$

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Srikanth Varma Chekuri (You) (Screen)

01:17:00

1 2 3 4 5 6 7 8 9 0

OK 00

46 People

Chat 5 Questions

Srikanth Varma Chekuri (You)

Chat

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pattern too ?...

karthik ponnappan To: Everyone 10:09 pm since we are assuming that data is normal distributed..

Sumit Raj To: Everyone 10:11 pm skewed

Sahil Chattonadhyay To: Everyone 10:15 pm 5 New Messages Yes No

To: Everyone Enable/Disable Chat

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1 $\hat{y}_i = f_L(x_i)$

2 $e_i = y_i - \hat{y}_i$; disb of errors

3 $e_i \notin N(0, \sigma^2) \Rightarrow \text{outliers}$

RANSAC

Srikanth Varma Chekuri (You)

Chat

Notify me about Nothing

(equation)

Pin a message +

ok

Aayush Saxena To: Everyone 10:25 pm so basically I remove the ith data point from the training data and re-train? (ith data point corresponding to y_i which gives large e_i)

Navroop To: Everyone 10:25 pm

GEOMRTT Yes No

To: Everyone Enable/Disable Chat

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Start Doubt Session

01:26:20

39 / 45

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Outliers:

Pin a message +

because looking at the joint pdf's are difficult right

Rakesh Inamdar To: Everyone 10:22 pm
one silly question: outliers may not always result in pull of linear function (model), there might also be outliers may be in same line, which may not alter the linear function (equation)

Start Doubt Session

Yes No

To: Everyone Enable/Disable Chat

Type message

01:23:39

40 / 43

InterviewBit Software Sery X Live | DSML Advanced X Underfitting-Overfitting.ip X Pearson correlation coeff X "VIF for a regression mode X

scaler.com/meetings/i/dsml-advanced-bias-variance-regularisation-cross-validation-2/live

DSML Advanced : Bias-Variance, Regularisation & Cross-Va...

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Srikanth Varma Chekuri (You)

Chat

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discussing...

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I have a silly question: Is more variance in data desirable? Cause more having variance can be because of outliers.

10:19 pm

10:20 pm

Start Doubt Session

Yes No

To: Everyone Enable/Disable Chat

Type message

GEOMRTT Srikanth Varma Chekuri (You) (Screen)

01:21:04

41 / 41

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DSML Advanced : Bias-Varianc...

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01:24:15

43 / 43

Srikanth Varma Chekuri (You)

Chat

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Siddarth To: Everyone 10:22 pm

to find out outliers properly, you have told to look at the distributions here should i look at the joint distribution of all the features or take each feature at a time and check its distribution. But the later method we have doing it from the beginning but taking a feature and looking at its boxplot remove the outliers, but still i can see some outliers. is it any better way to remove

GEOMRTT Yes No

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DSML Advanced : Bias-Variance, Regularisation & Cross-Va...

Q GEOFRTT e_i's

$e_i \sim N(0, \sigma)$

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Srikanth Varma Chekuri (You) (Screen)

01:24:27

43 / 43

88 00 Srikanth Varma Chekuri (You)

Chat

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Siddarth To: Everyone 10:22 pm

to find out outliers properly, you have told to look at the distributions here should i look at the joint distribution of all the features or take each feature at a time and check its distribution. But the later method we have doing it from the beginning but taking a feature and looking at its boxplot remove the outliers, but still i can see some outliers. is it any better way to remove

Start Doubt Session

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Yes No

46 People

Chat

5 Questions

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

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GEOMRTT

Srikanth Varma Chekuri (You) (Screen)

01:25:56

44 / 44

Srikanth Varma Chekuri (You)

Chat

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Rakesh Inamdar To: Everyone 10:22 pm
one silly question: outliers may not always result in pull of linear function (model), there might also be outliers may be in same line, which may not alter the linear function (equation)

Siddarth To: Everyone 10:25 pm
ok

Yes No

To: Everyone Enable/Disable Chat

Type message

46 People

Chat 5 Questions

Start Doubt Session

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DSML Advanced : Bias-Varianc...

bg (y)

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Srikanth Varma Chekuri (You) (Screen)

01:26:53

45 / 45

Srikanth Varma Chekuri (You)

Chat

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Pin a message

so basically I remove the ith data point from the training data and re-train? (ith data point corresponding to y_i which gives large e_i)

• Navroop To: Everyone 10:25 pm

read somewhere one way to fix the non-normality in the errors is to transform the target space.

Start Doubt Session

Yes No

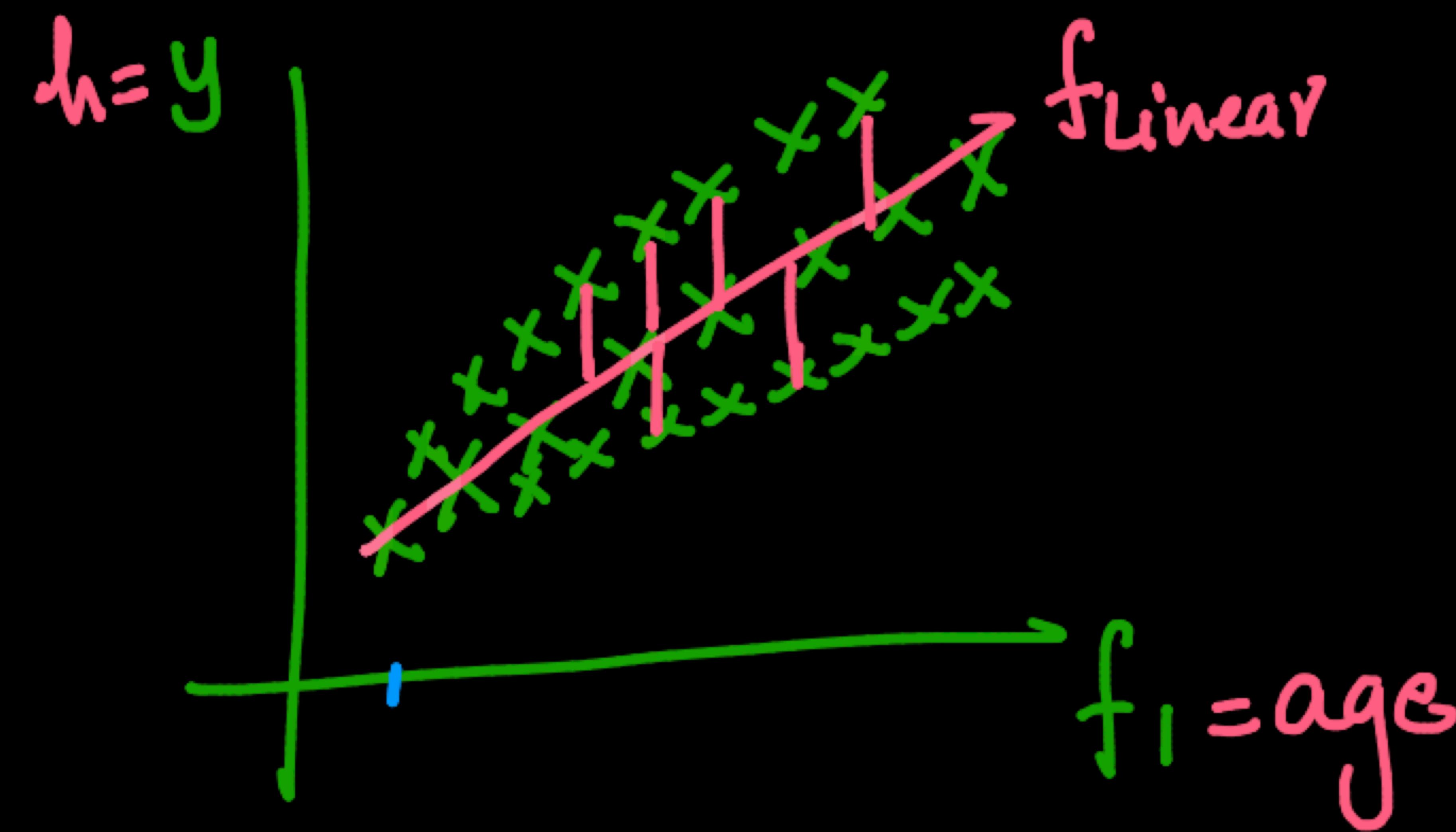
To: Everyone Enable/Disable Chat

Type message

45 / 45

④

hetero statistic^{ity} should not exist



white Test

Residual-plot

math / stats past!

$\{ e_i \sim N(0, \sigma^2) \}$

not constant

Notify me about
unmute me please

Pin a message

Sabuj Chattpadhyay To: Everyone 10:41 pm

Aayush Saxena To: Everyone 10:43 pm

Deepak Kumar To: Everyone 10:43 pm

Start Doubt Session

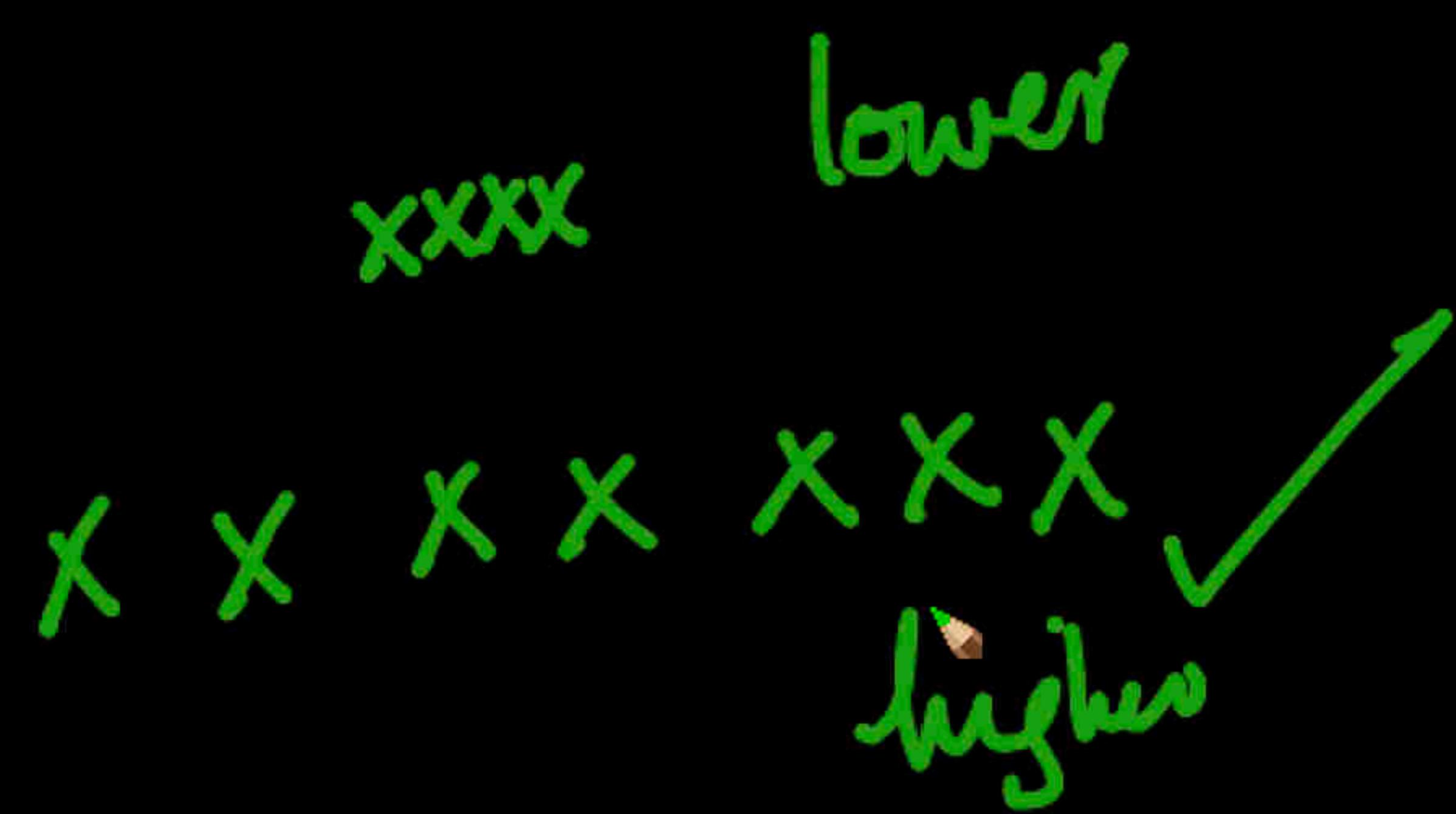
To: Everyone Enable/Disable Chat

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01:44:32

47 / 52

Variance in errors changes with
observed y_i 's



$$y = \underline{\omega}^T \underline{x} + \underline{\omega}_0 + e$$

errors

$$e \sim N(0, \sigma^2)$$

$$e_i: l \rightarrow n$$
$$N(0, \sigma^2)$$

n is large enough

pop
data

sample

Dtrain: $l \rightarrow n$

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01:37:59

GEOMRTT

44 People

Chat

Questions 5

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Pin a message +

Siddarth To: Everyone 10:35 pm

ei means ith error for ith observation right? and as it is a random variable so it can have its own distribution with its own mean and std right. and here the assumption is all the errors should have this std. But here we are looking all the errors at a time and telling depending on the shape, i am not getting the intution

Yes No

To: Everyone Enable/Disable Chat

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Chat

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unmute me please

Pin a message + New

Sabuj Chattopadhyay To: Everyone 10:41 pm

How can a y_i can have multiple errors as in that diagram?

Aayush Saxena To: Everyone 10:43 pm

each error point is $y_i - \hat{y}_i$

Deepak Kumar To: Everyone 10:43 pm

One silly question here the data are equally

Start Doubt Session

To: Everyone Enable/Disable Chat

Type message

01:44:44

52 / 52

People 43

Chat 5

Questions

Start Doubt Session

Yes No

Update

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ei

yi

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GEOMRTT

Srikanth Varma Chekuri (You) (Screen)

01:46:04

52 / 53

Srikanth Varma Chekuri (You)

Chat

Notify me about Nothing

Pin a message

each error point is yi-yihat @Sabuj

Deepak Kumar To: Everyone 10:43 pm

One silly question here the data are equally distributed across the axis and it is spreading out across the axis moving forward?

Sabuj Chattopadhyay To: Every... 10:44 pm

Yeah visually it looked awkward

Start Doubt Session

To: Everyone Enable/Disable Chat

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43 People

5 Questions

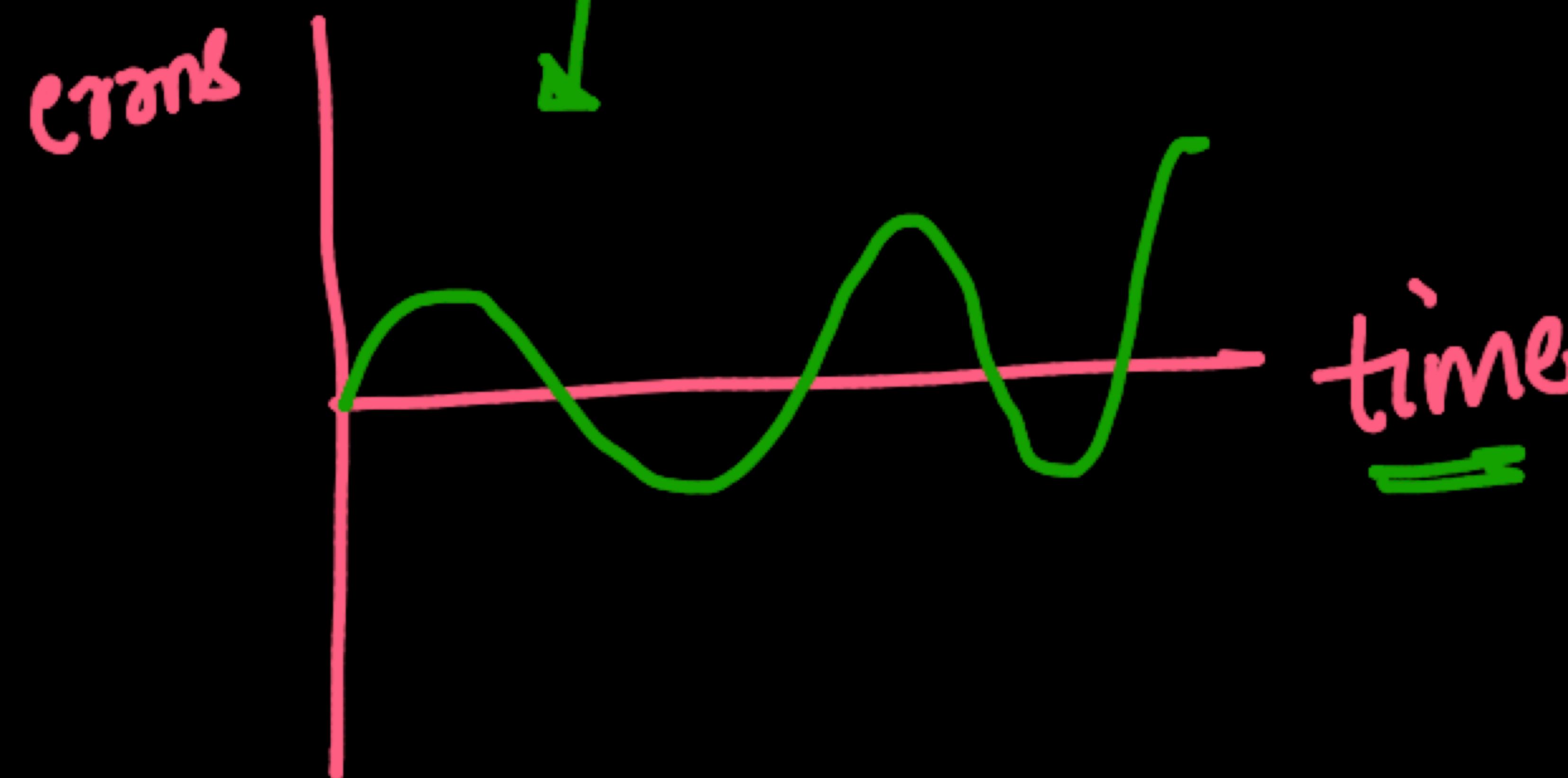
Lightbulb icon

Start Doubt Session

Red button

⑤

No Autocorrelation 
time-series analysis



y_i : #sales

- {
 - Linearity
 - No Multicollinearity
 - No Auto-Corr (time series)
 - Errors are $N(0, \sigma^2)$
 - No Heteroskedasticity
 - (x_i, y_i) are a random sample

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Can we build Lx-Reg model if some assumptions are not met

— Yes

(Careful)

Look out for ways that the model break

Srikanth Varma Chekuri (You) (Screen)

01:51:16

00:00

People 43

Chat

Questions 5

Notify me about Nothing

Saurabh Bhondokar To: Everyone 10:50 pm Pin a message +

Sabuj Chattopadhyay To: Every... 10:50 pm Approximately yes 10:50 pm

Vishal Gaurav To: Everyone 10:50 pm

GEOMRTT Yes No

To: Everyone Enable/Disable Chat

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Start Doubt Session

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GEOMRTT

D_{Train} (80%)

D_{Test} (20%)

R²

R² Test

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Model

never use - unseen-data

Srikanth Varma Chekuri (You)

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Saurabh Bhondokar To: Everyone 10:50 pm Pin a message +

Sabuj Chattopadhyay To: Every... 10:50 pm Approximately yes

Vishal Gaurav To: Everyone 10:50 pm Yes.

Start Doubt Session

To: Everyone Enable/Disable Chat

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01:53:25

56 / 56

Diagram Description: The diagram shows a flow from raw data D[0,000] through training (D Train, 80%) to a model. The test set (D Test, 20%) is highlighted with a pink circle. Handwritten notes indicate R^2 for both training and testing phases, and a warning against using unseen data.

Handwritten Notes:

- GEOMRTT
- D_{Train} (80%)
- D_{Test} (20%)
- R²
- R² Test
- You are sharing your screen now
- Stop Sharing
- Model
- never use - unseen-data

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GEOMRTT

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Underfitting
& overfitting

Bias-variance tradeoff

Srikanth Varma Chekuri (You)

Chat

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Vishal Gaurav To: Everyone 10:50 pm yes.

Saurabh Bhondekar To: Everyone 10:53 pm we can also use a validation set for checking model's progress in iterations and not touch test set

Start Doubt Session

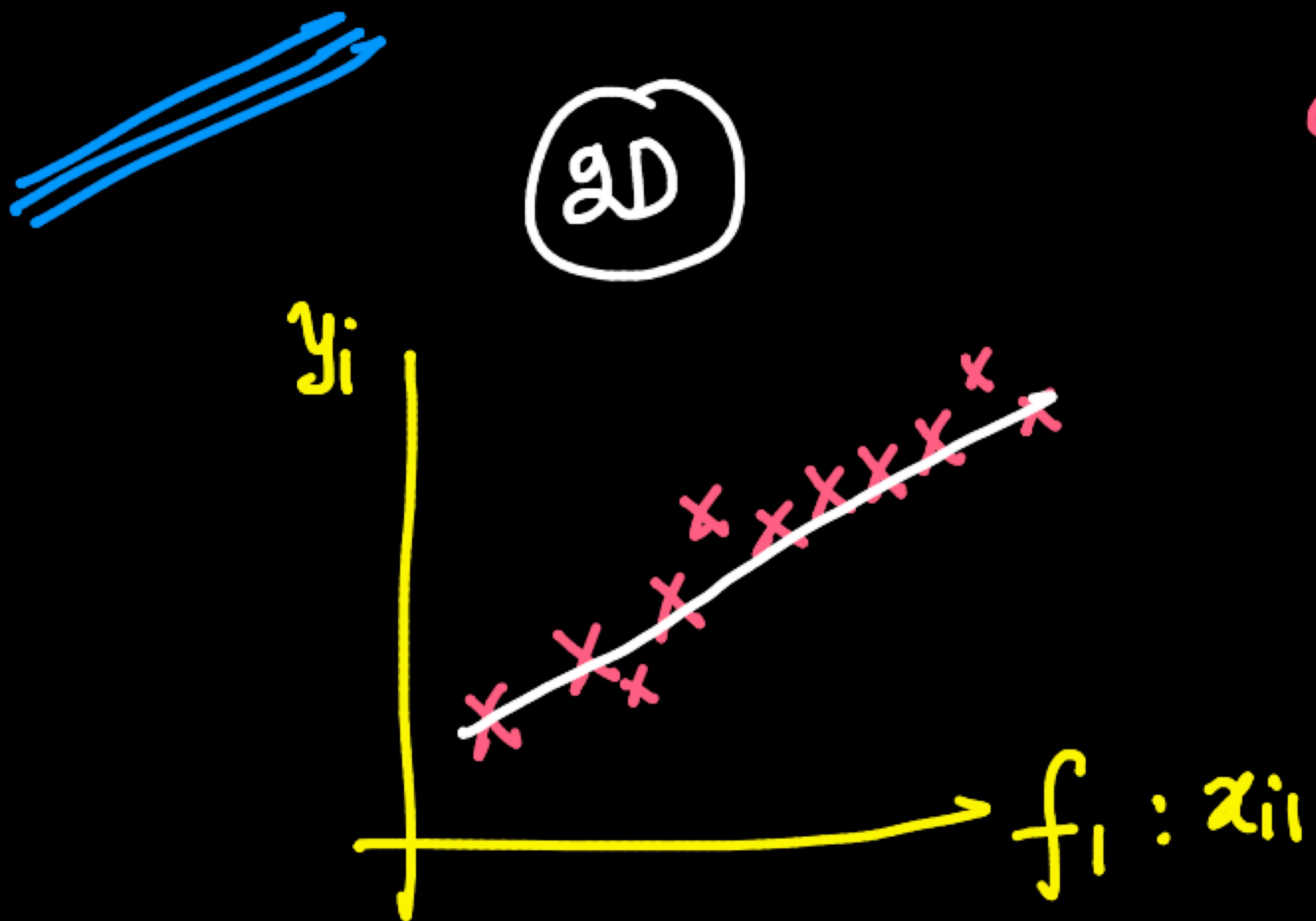
Yes No

To: Everyone Enable/Disable Chat

Type message

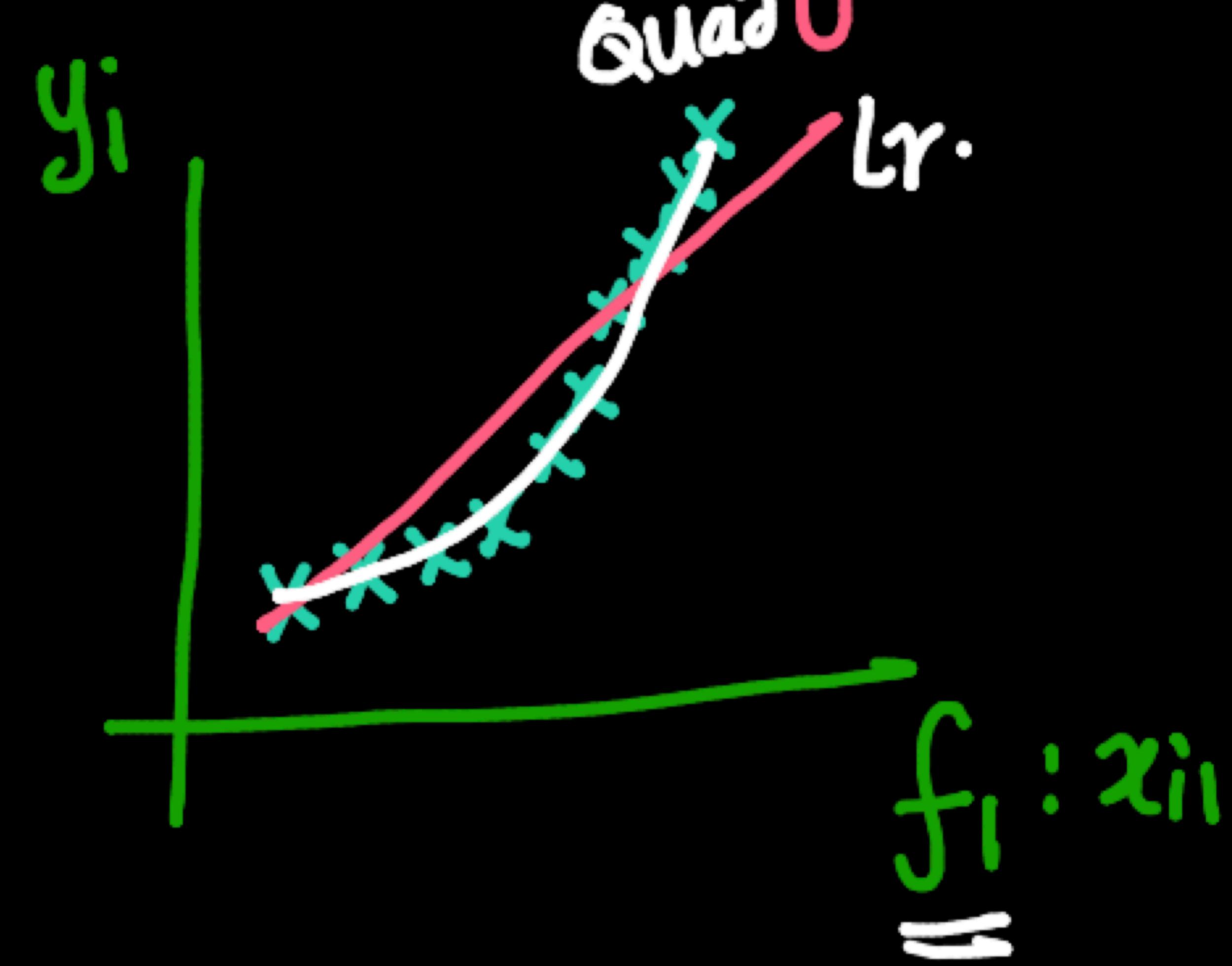
01:54:28

57 / 57



L_r. Reg ✓

Extend Linear regression



$L_r \rightarrow e_i$'s are high

y_i ↘

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Can I modify Lr-reg to make it work in Quad case?

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$$\sum_{i=1}^n (y_i - \hat{y}_i)^2$$

($\omega^T x_i + b$)

Srikanth Varma Chekuri (You) (Screen)

02:04:44

83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99

59 / 59

Srikanth Varma Chekuri (You)

Chat

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to accomodate errors

Tejaswi prakash To: Everyone 11:02 pm use two lines ?

Saurabh Bhondekar To: Everyone 11:03 pm quadratic cost function and gradient descent ?

Start Doubt Session

To: Everyone Enable/Disable Chat

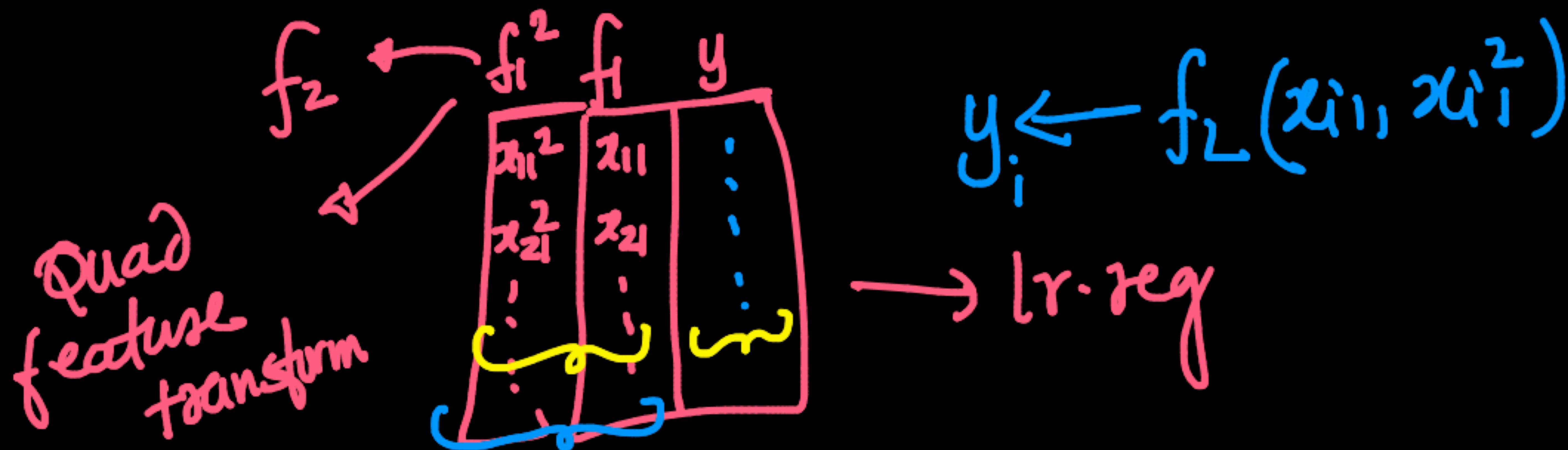
Type message

Lr. fn:

$$y_i \approx w_1 x_{i1} + w_0$$

Quad fn:

$$y_i \approx w_1 \underline{x_{i1}} + \underline{w_0} + w_2 \underline{x_{i1}^2}$$



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GEOMRTT

$f_1 \quad f_1^2$

$f_1^2 = d_1 f_1 + \epsilon_0$

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$w_1 \quad w_2$

no MC

Srikanth Varma Chekuri (You)

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Fitting a polynomial function instead of linear?

karthik ponnappan To: Everyone 11:07 pm
but these will have high collinearity between x and xsq right...

11:08 pm

3

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To: Everyone Enable/Disable Chat

Type message

02:09:31

61 / 61

People 41

Chat

Questions 7

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$f_1, f_1^2, \sqrt{f_1}, f_1^3, \log(f_1)$

$f_1 e^{f_1} \dots$

$y_i - \hat{y}_i$

Srikanth Varma Chekuri (You) (Screen)

02:10:51

88% 62 / 62

88%

00

Srikanth Varma Chekuri (You)

Chat

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Pin a message +

and $(x_i)^2$

Arijit Bhowmick To: Everyone 11:10 pm
what will happen to our curve now ? bcoz it is quadratic now, will it come closer to the actual points ?

Navroop To: Everyone 11:10 pm
what is the purpose of doing $y_i = (f_1^2, f_1)$?

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Yes No

41 People

Chat

7 Questions

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DSML Advanced : Bias-Variance, Regularisation & Cr...

00

40 People

Chat

Questions 7

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$f_1, f_1^2 \xrightarrow{\text{LR-model}} y_i$

e_i 's are small

e_i 's were large

Srikanth Varma Chekuri (You)

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is quadratic now, will it come closer to the actual points ?

• Navroop To: Everyone 11:10 pm

what is the purpose of doing $y_i = (f_1^2, f_1)$?

• Rohit Sinha To: Everyone 11:10 pm

got it, does it actually help (any example that you are aware of) ?

4 New Messages

Start Doubt Session

Srikanth Varma Chekuri (You) (Screen)

02:13:52

63 / 63

To: Everyone Enable/Disable Chat

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Yes No

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$f_1, f_2, \dots, f_{10} \xrightarrow{LR} y_i$

$\sigma = 10 (\text{det})$

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$\{f_1, f_1^2, f_2, f_2^2 \dots, f_{10}, f_{10}^2\}$

$LR \rightarrow y_i \rightarrow \sigma = 1$

Srikanth Varma Chekuri (You) (Screen)

02:16:17

OK 00 Srikanth Varma Chekuri (You)

Chat

Notify me about Nothing

It's basically a linear fit with variables y_i :

Vishal Gaurav To: Everyone 11:11 pm if we have n features(e.g. n=10), how can we know polynomial relation exist between the target and which features?

Rohit Sinha To: Everyone 11:11 pm sure, thank you.

Siddarth To: Everyone 11:11 pm 5 New Messages

GEOMRTT Yes No

To: Everyone Enable/Disable Chat

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People 38

Chat

Questions 7

 DSML Advanced : Bias-Variance, Regularisation & Cross-Val...

Lx-model

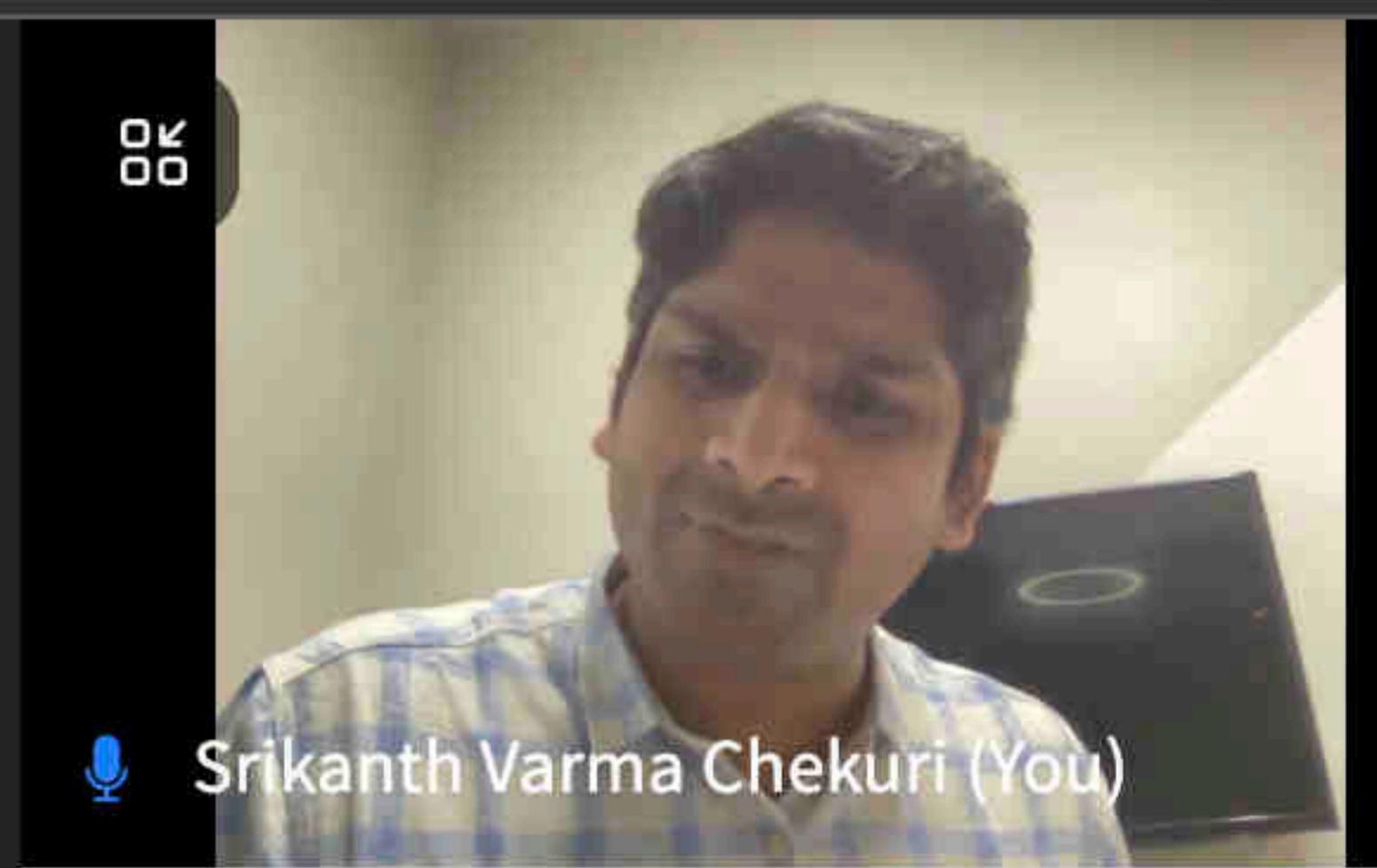
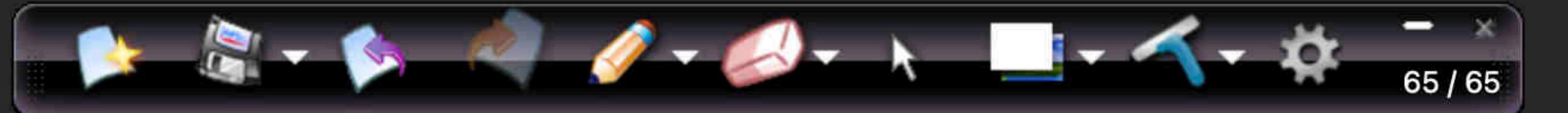
detect & remove attack e_i

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 Srikanth Varma Chekuri (You) (Screen

02:18:17



Chat

Notify me about

Nothing

Pin a message

+

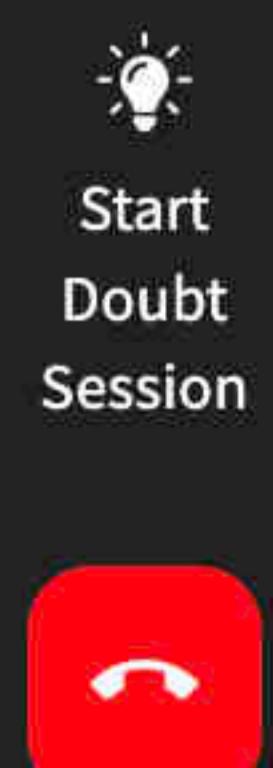
since we are building tis intuition based on high error.. is there a way to identify if its due to outliers or quadratic pattern??

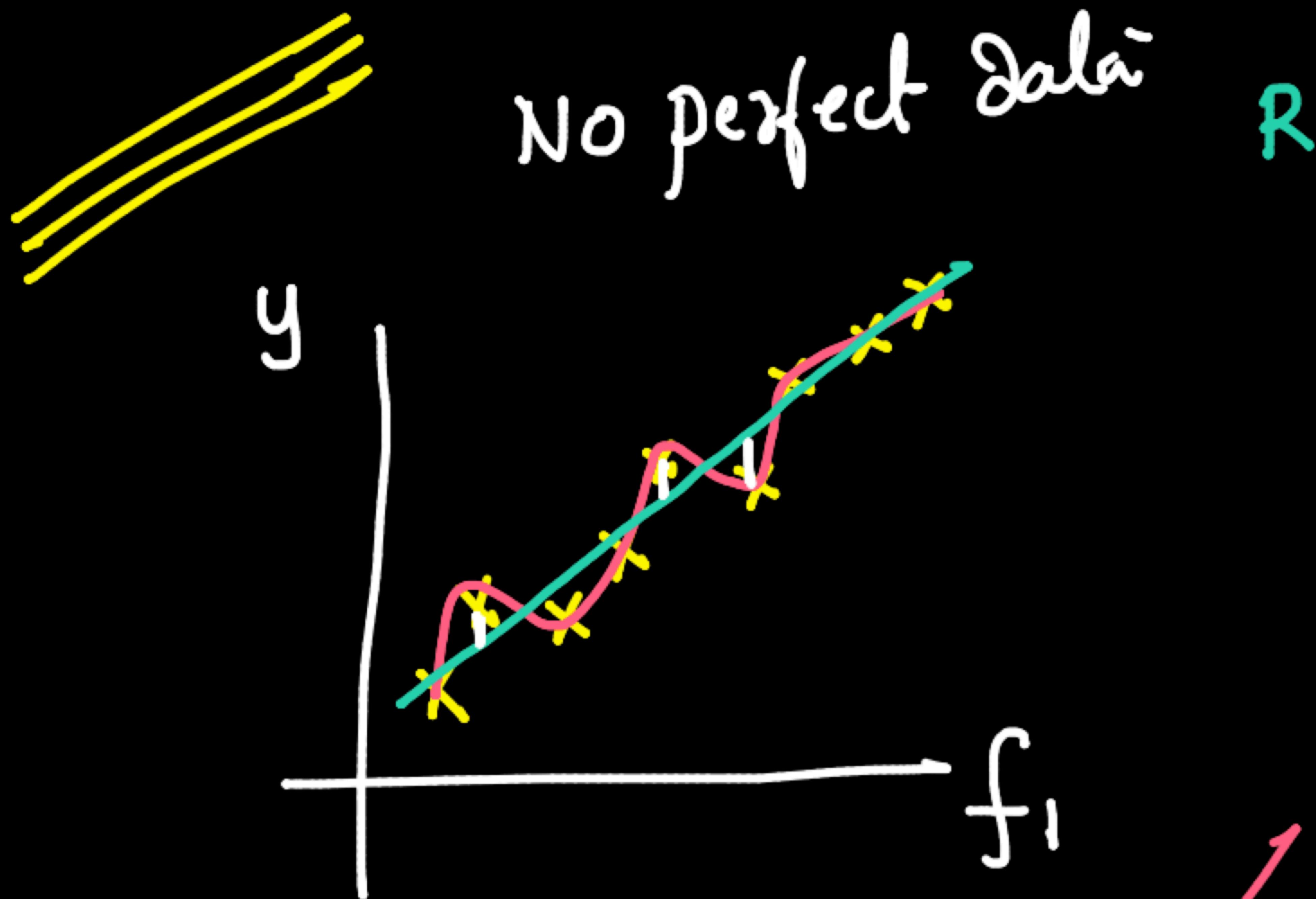
• **Rohit Sinha** To: Everyone 11:15 pm
@karthik, I would say if there are large error for significant number of data points, then it would be a good time to think about

GEOMRTT

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RISK of adding
too many transformed
features

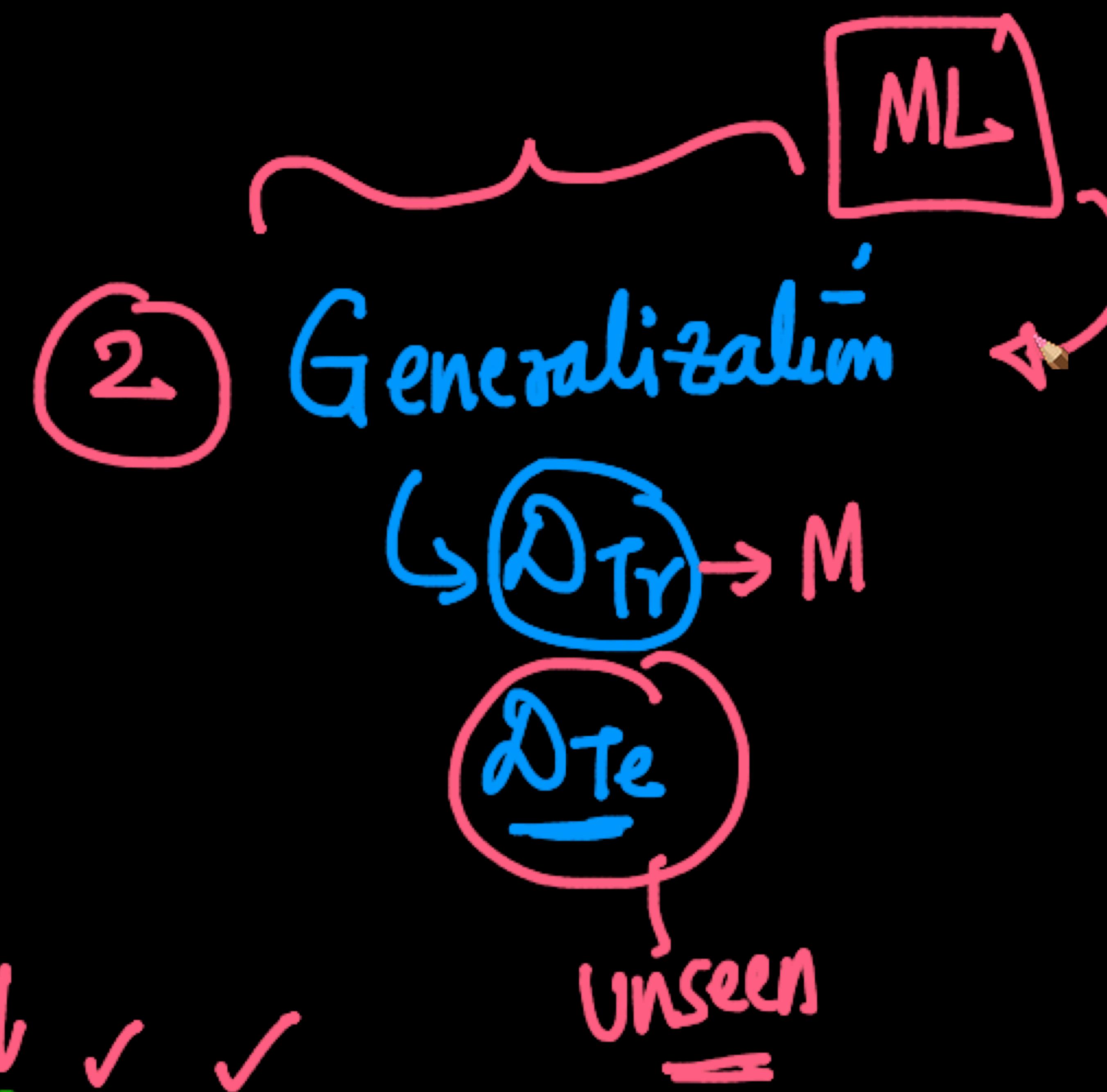
$$f_1, f_1^2, f_1^3, \cancel{f_1^4}, \dots$$

↓

$$\dots, \cancel{f_1^{20}}$$

{ Simple → lr. model ✓
Complex → non-lr. model ✗

1 Occam's
Razor



[pick the
Simpler model

$$\nabla \{ F = G \frac{m_1 m_2}{r^2} \}$$



+ Code



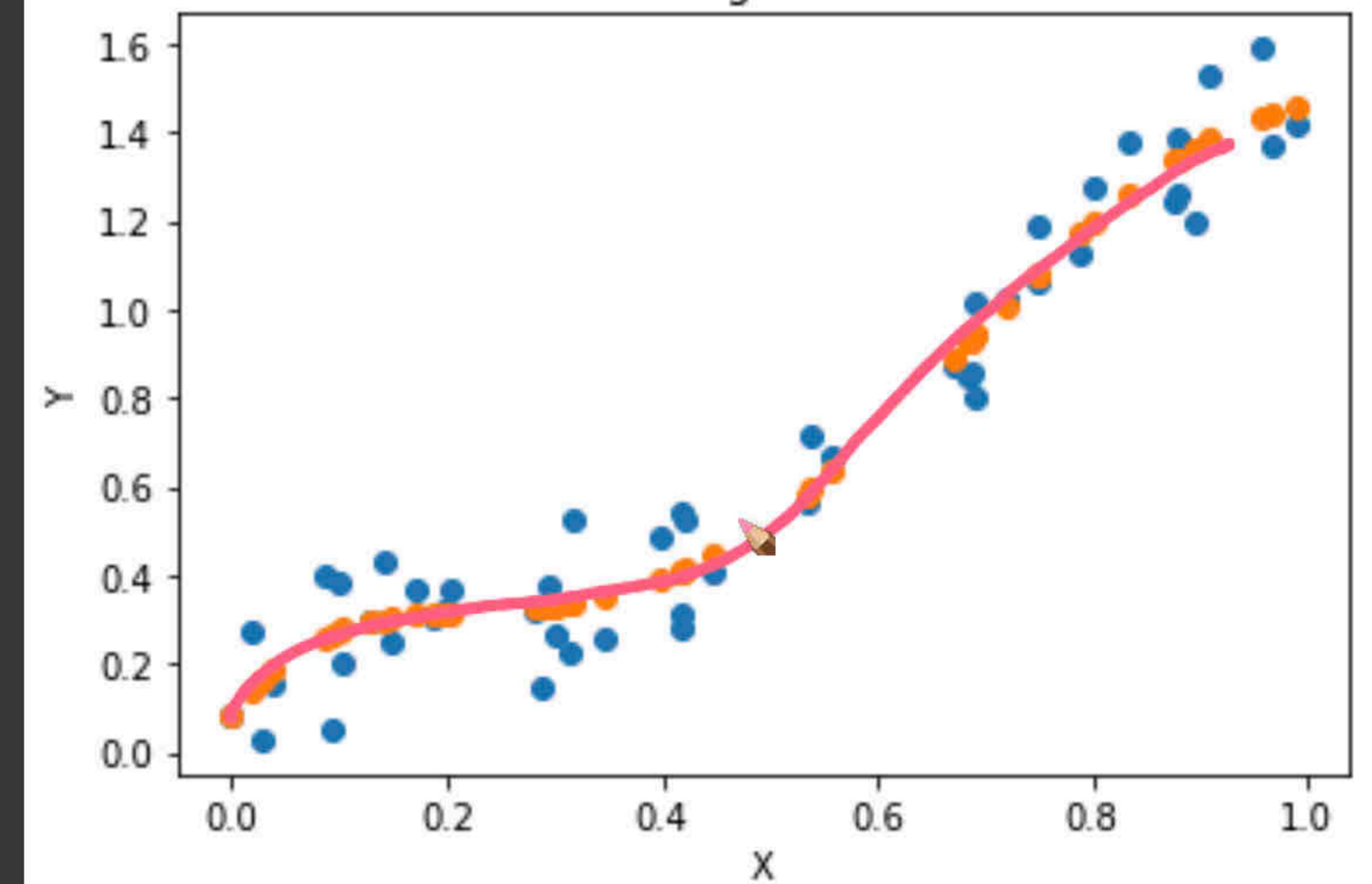
[]



0.950995835560793



{x}



0.9515258649694076



Reconnect

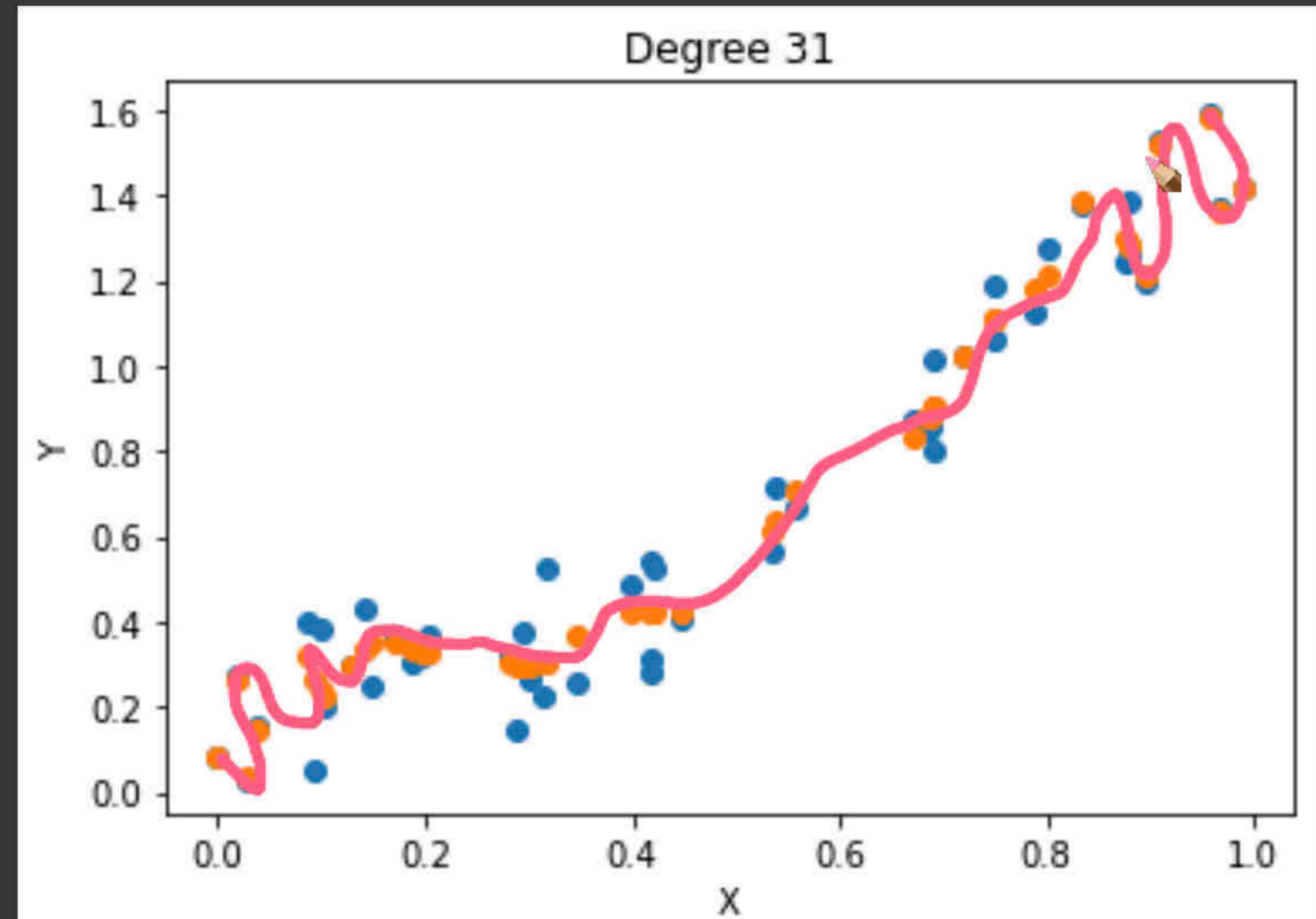


+ Code + Text

Reconnect



```
scores.append(model.score(X_poly_scaled, y))
```



0.9684331040517228

```
[ ] # lets first generate a dataset of 100 points this time
```

```
In [1]: np.random.seed(1)
```

```
X = np.linspace(0, 1, 100)
```

```
y = 0.5 * (X**5) + 0.5 * (X**3) + 0.5 * (X**2) + 0.5 * X + 0.5 * np.sin(2 * np.pi * X) + 0.5 * np.random.randn(100)
```

```
Out[1]:
```

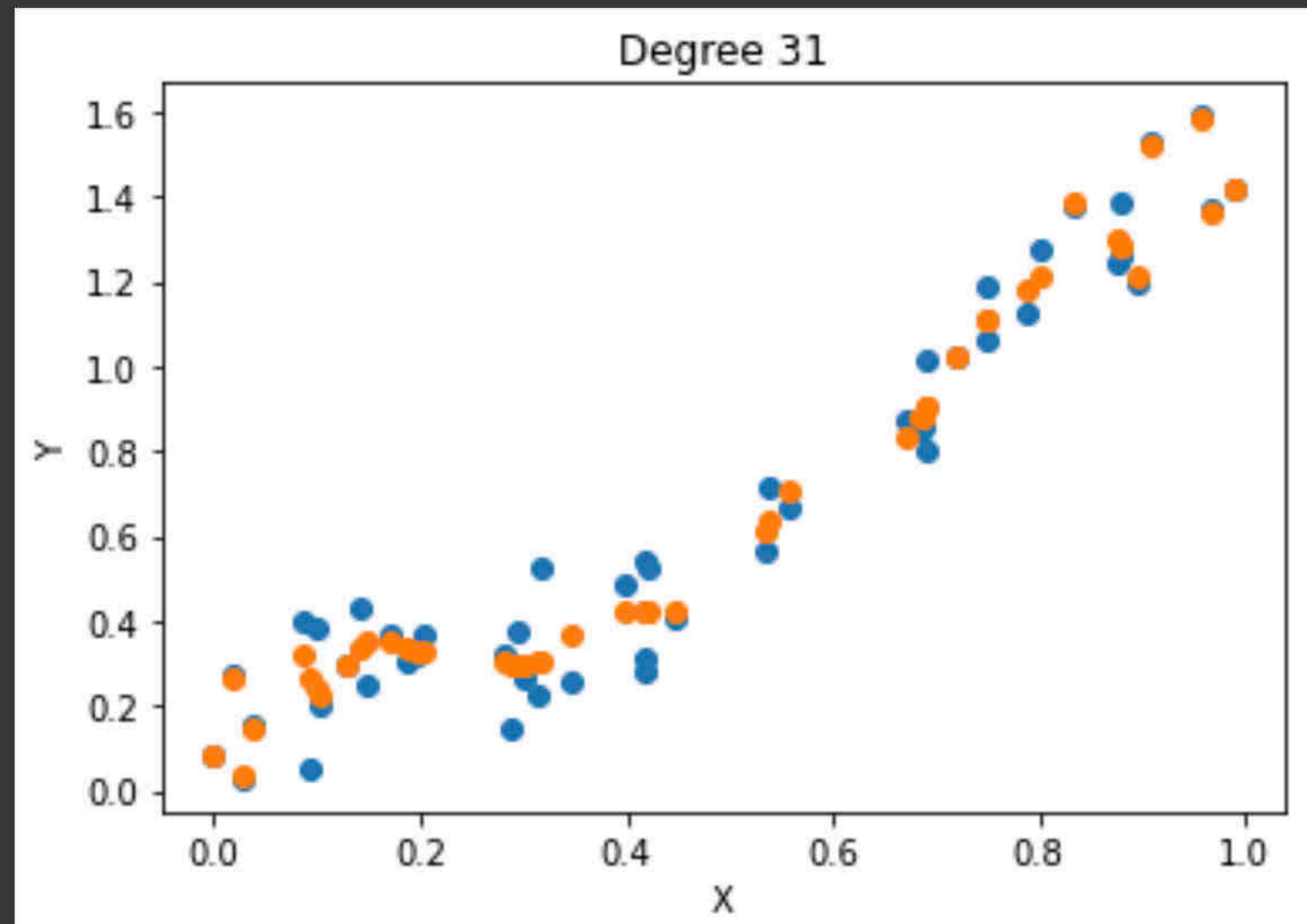
```
array([ 0.5       ,  0.5623413 ,  0.6246826 ,  0.6870239 ,  0.7493652 ,  0.8117065 ,  0.8740478 ,  0.9363891 ,  1.0      ,  1.0623413 ,  1.1246826 ,  1.1870239 ,  1.2493652 ,  1.3117065 ,  1.3740478 ,  1.4363891 ,  1.4987304 ,  1.5610717 ,  1.623413 ,  1.6857547 ,  1.748096 ,  1.8104373 ,  1.8727786 ,  1.9351199 ,  1.9974612 ,  2.0608025 ,  2.1231438 ,  2.1854851 ,  2.2478264 ,  2.3001677 ,  2.352509 ,  2.4048503 ,  2.4571916 ,  2.5095329 ,  2.5618742 ,  2.6142155 ,  2.6665568 ,  2.7188981 ,  2.7712394 ,  2.8235807 ,  2.875922 ,  2.9282633 ,  2.9806046 ,  3.0329459 ,  3.0852872 ,  3.1376285 ,  3.1899698 ,  3.2423111 ,  3.2946524 ,  3.3469937 ,  3.399335 ,  3.4516763 ,  3.5030176 ,  3.5553589 ,  3.6076902 ,  3.6590315 ,  3.7113728 ,  3.7637141 ,  3.8160554 ,  3.8683967 ,  3.920738 ,  3.9730793 ,  4.0254206 ,  4.0777619 ,  4.1301032 ,  4.1824445 ,  4.2347858 ,  4.2871271 ,  4.3394684 ,  4.3918097 ,  4.444151 ,  4.4964923 ,  4.5488336 ,  4.5911749 ,  4.6435162 ,  4.6958575 ,  4.7481988 ,  4.7905301 ,  4.8428714 ,  4.8952127 ,  4.947554 ,  5.0      ,  5.0623413 ,  5.1246826 ,  5.1870239 ,  5.2493652 ,  5.3117065 ,  5.3740478 ,  5.4363891 ,  5.4987304 ,  5.5610717 ,  5.623413 ,  5.6857547 ,  5.748096 ,  5.8104373 ,  5.8727786 ,  5.9351199 ,  5.9974612 ,  6.0608025 ,  6.1231438 ,  6.1854851 ,  6.2478264 ,  6.3001677 ,  6.352509 ,  6.4048503 ,  6.4571916 ,  6.5095329 ,  6.5618742 ,  6.6142155 ,  6.6665568 ,  6.7188981 ,  6.7712394 ,  6.8235807 ,  6.875922 ,  6.9282633 ,  6.9806046 ,  7.0329459 ,  7.0852872 ,  7.1376285 ,  7.1899698 ,  7.2423111 ,  7.2946524 ,  7.3469937 ,  7.399335 ,  7.4516763 ,  7.5030176 ,  7.5553589 ,  7.6076902 ,  7.6590315 ,  7.7113728 ,  7.7637141 ,  7.8160554 ,  7.8683967 ,  7.920738 ,  7.9730793 ,  8.0254206 ,  8.0777619 ,  8.1301032 ,  8.1824445 ,  8.2347858 ,  8.2871271 ,  8.3494684 ,  8.4018097 ,  8.454151 ,  8.5064923 ,  8.5588336 ,  8.6111749 ,  8.6635162 ,  8.7158575 ,  8.7681988 ,  8.8205301 ,  8.8728714 ,  8.9252127 ,  8.977554 ,  9.0308963 ,  9.0832376 ,  9.1355789 ,  9.1879202 ,  9.2402615 ,  9.2926028 ,  9.3449441 ,  9.3972854 ,  9.4506267 ,  9.502968 ,  9.5553093 ,  9.6076506 ,  9.6599919 ,  9.7123332 ,  9.7646745 ,  9.8170158 ,  9.8693571 ,  9.9216984 ,  9.9740407 ,  10.0      ])
```

```
Out[1]:
```

```
69 / 69
```

+ Code + Tex

Reconnect ▾



0.9684331040517228

```
[ ] # lets first generate a dataset of 100 points this time
```

nr random good / 1

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

R² train

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R² test

=

generalization

GEOMRTT

Srikanth Varma Chekuri (You) (Screen)

02:37:08

00:00

Srikanth Varma Chekuri (You)

Questions

Live (6) Answered (2)

Recently asked

Asked 89 minutes ago

Rohit Sinha

Prior to dropping some features I have R-Squared/adjusted R-Squared around 0.82. Considering VIF for some features (let's say VIF to be between 4-6), I drop those features but then my model's R-Squared drops to around 0.7. What is advisable here?

Already Answered Answer Now

Asked 94 minutes ago

1 6

People Chat Questions

Doubt Session Ongoing

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DSML Advanced : Bias-Varianc...

$d=10$

$n=1\text{Million}$

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GEOMRTT

Srikanth Varma Chekuri (You) (Screen)

02:37:59

00:00

Srikanth Varma Chekuri (You)

Questions

Live (5) Answered (3)

Recently asked

Already Answered Answer Now

Asked 81 minutes ago

karthik ponnappan

if we have a huge data if it fine if we fine this multicollinearity for a sample.. and assume that this will follow the pattern or will we have to do any further checks as well..?

Already Answered Answer Now

Asked 90 minutes ago

Doubt Session Ongoing

People 27 Chat 1 Questions 5

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

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Srikanth Varma Chekuri (You) (Screen)

02:38:13

1 People

1 Chat

5 Questions

Questions

Live (5) Answered (3)

Recently asked

Asked 81 minutes ago

karthik ponnappan

if we have a huge data if it fine if we fine this multicollinearity for a sample.. and assume that this will follow the pattern or will we have to do any further checks as well..?

GEOMRTT

Already Answered Answer Now

Asked 90 minutes ago

Doubt Session Ongoing

1 0

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0.9 = R^2_{Train}

R^2_{Test}

0.6

GEOMRTT

Aayush Saxena

People

Search

Srikanth Varma Chekuri (Host, You)

Aayush Saxena Raised hand

AV Adarsh Vinayak

Aditya Yadav

Arijit Bhowmick

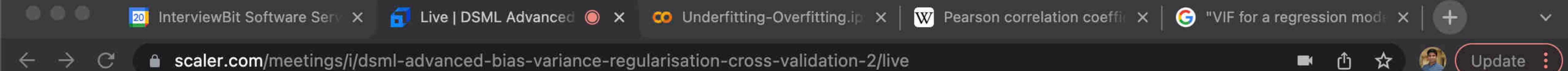
AD Avijit Das

BR Bharat Rayasam

Doubt Session Ongoing

02:41:50

74 / 74



A hand-drawn diagram on a black background illustrating concepts related to machine learning performance metrics and cross-validation.

The diagram features:

- A bracket on the left labeled "1.0" pointing to a small drawing of a bone.
- An arrow pointing from the bone towards a large circle labeled "R² Train".
- A large circle labeled "R² Test" with the word "Unseen" written below it.
- A circle labeled "y_i, y_i[̂]" with a curved arrow pointing from it to the "R² Test" circle.
- A blue button labeled "Stop Sharing" located between the "y_i, y_i[̂]" circle and the "R² Test" circle.
- A message "You are sharing your screen now" displayed above the "Stop Sharing" button.
- A handwritten value "0.5" with a pink marker.

On the right side of the screen, there is a sidebar titled "People" which lists participants in the session:

- Srikanth Varma Chekuri (Host, You)
- Aayush Saxena
- Adarsh Vinayak
- Aditya Yadav
- Arijit Bhowmick
- Bharat Rayasam
- Harsh

At the bottom right, there are buttons for "Doubt Session Ongoing" and "GEOMRTT".

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DSML Advanced : Bias-Variance, Regularisation & Cross-Va...

one-hot mean/median MC

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Srikanth Varma Chekuri (You) (Screen)

02:47:20

00:00

Srikanth Varma Chekuri (You)

Questions

Live (1) Answered (8)

Recently asked

Note: Please click on “Answer Now” button before you start explaining the doubt to perfectly map it with the classroom video.

Rajesh

How we can treat our non-ordinal categorical features in LR, especially in the assumption for linearity check? also if we do mean encoding does column standardisation make sense

GEOMRTT

Already Answered Answer Now

Asked 10 minutes ago 0

People 21 Chat Questions 1

The screenshot shows a live video conference interface. The main video frame on the right shows Srikanth Varma Chekuri. The sidebar on the right contains a 'Questions' section with 'Live (1)' and 'Answered (8)' buttons, and a note about clicking 'Answer Now'. A handwritten note on the screen says 'one-hot mean/median MC'. The bottom right corner has a 'Doubt Session Ongoing' button. The bottom left corner shows a timer at 02:47:20 and a progress bar at 76/76.

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

MC → feat. Imp.

$$\hat{y}_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

You are sharing your screen now

Stop Sharing

$$x_2 = d_0 + d_1 x_1$$

GEOMRTT

Srikanth Varma Chekuri (You) (Screen)

02:49:03

Rakesh Inamdar

People

- Srikanth Varma Chekuri (Host, You)
- Rakesh Inamdar Raised hand
- Aayush Saxena
- Adarsh Vinayak
- Aditya Yadav
- Arijit Bhowmick
- Bharat Rayasam

Doubt Session Ongoing

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

GEOMRTT

$$\hat{y}_i = \omega_0 + \omega^T x_i + \epsilon_i \sim N(0, \sigma^2)$$

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random \neq Normal disb.

Srikanth Varma Chekuri (You) (Screen)

02:51:30

Rakesh Inamdar

People

- Srikanth Varma Chekuri (Host, You)
- Aayush Saxena
- Rakesh Inamdar
- Adarsh Vinayak
- Aditya Yadav
- Arijit Bhowmick
- Bharat Rayasam

Doubt Session Ongoing

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

heteroskedasticity

$\epsilon_i \rightarrow y_i's$

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Srikanth Varma Chekuri (You) (Screen)

02:51:21

Rakesh Inamdar

People

Search

- Srikanth Varma Chekuri (Host, You)
- Aayush Saxena
- Rakesh Inamdar
- Adarsh Vinayak
- Aditya Yadav
- Arijit Bhowmick
- Bharat Rayasam

Doubt Session Ongoing

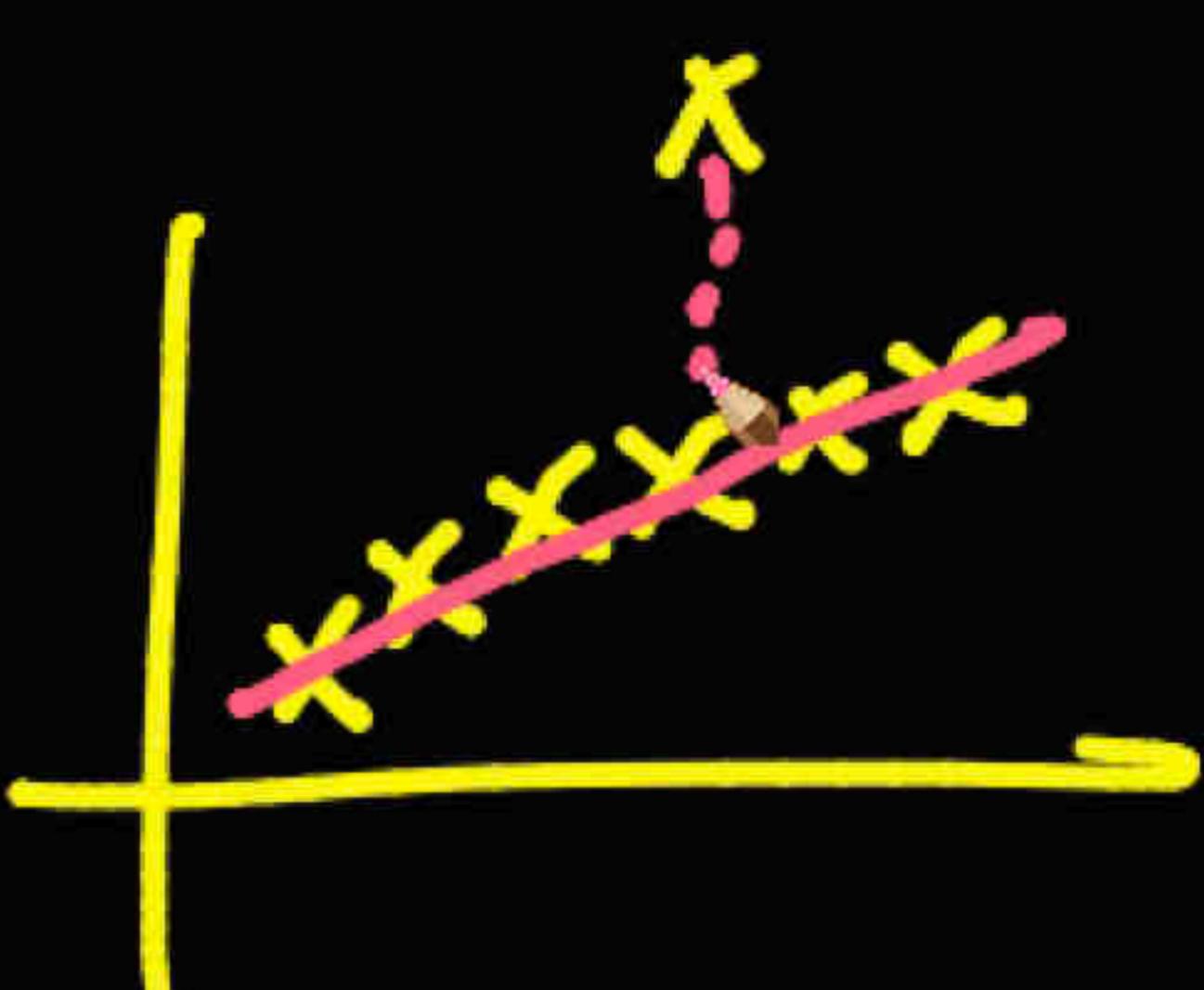
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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

outliers:



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Srikanth Varma Chekuri (You) (Screen)

02:52:14

Rakesh Inamdar

People

- Srikanth Varma Chekuri (Host, You)
- Aayush Saxena
- Rakesh Inamdar
- Adarsh Vinayak
- Aditya Yadav
- Arijit Bhowmick
- Bharat Rayasam

GEOMRTT

Doubt
Suggestion
Ding Dong

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

sklearn → GD → p-values

R → OLS → p-values

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w₀, w₁, w₂, ...

w_j → r.v → t - J ✓

Srikanth Varma Chekuri (You) (Screen)

02:56:14

81 / 81

Rakesh Inamdar

People

Srikanth Varma Chekuri (Host, You)

Aayush Saxena

Rakesh Inamdar

Adarsh Vinayak

Aditya Yadav

Arijit Bhowmick

Bharat Rayasam

Chat

Questions

Doubt Session Ongoing

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DSML Advanced : Bias-Varianc... Regularisation & Cross-Validation

reg → optimizn → P&S

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Srikanth Varma Chekuri (You) (Screen)

02:59:19

Rakesh Inamdar

People

Search

Srikanth Varma Chekuri (Host, You)

Aayush Saxena

Rakesh Inamdar

Adarsh Vinayak

Aditya Yadav

Arijit Bhowmick

Bharat Rayasam

Doubt Session Ongoing GEOMRTT

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DSML Advanced : Bias-Variance, Regularisation & Cross-Validation

MC

$f_1 \ f_2 \dots f_d$

y_i dep

indep var

You are sharing your screen now

Stop Sharing

03:00:42

83 / 83

Srikanth Varma Chekuri (You) (Screen)

Srikanth Varma Chekuri (You)

00

GEOMRTT

Chat

Questions

Doubt Session Ongoing

People 17

Notify me about Nothing

Pin a message

• Tejaswi prakash To: Everyone 11:46 pm

thanks

• Siddarth To: Everyone 11:53 pm

i know its very late to ask this question. we say the target variable as dependant variable and input variable as the independant variables right, what does the independance mean here?

Yes No

To: Everyone Enable/Disable Chat

Type message

Update

17

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DSML Advanced : Bias-Variance, Regularisation & Cross-Va...

fi fi²

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Srikanth Varma Chekuri (You) (Screen)

03:01:18

84 / 84

Srikanth Varma Chekuri (You)

Chat

Notify me about Nothing

Pin a message

say the target variable as dependant variable and input variable as the independant variables right, what does the independance mean here?

● Siddarth To: Everyone 12:00 am

so if we create new features by squaring or something then these two variables are dependant right

GEOMRTT Yes No

To: Everyone Enable/Disable Chat

Type message

Doubt Session Ongoing

17 People

Chat

Questions

GEOMRTT

Yes No

Enable/Disable Chat

Type message

Update

You have left the meeting

We get frequent requests for your notes!

Notes written by you helps in understanding the topic better. You can upload the notes in two simple steps mentioned below

1

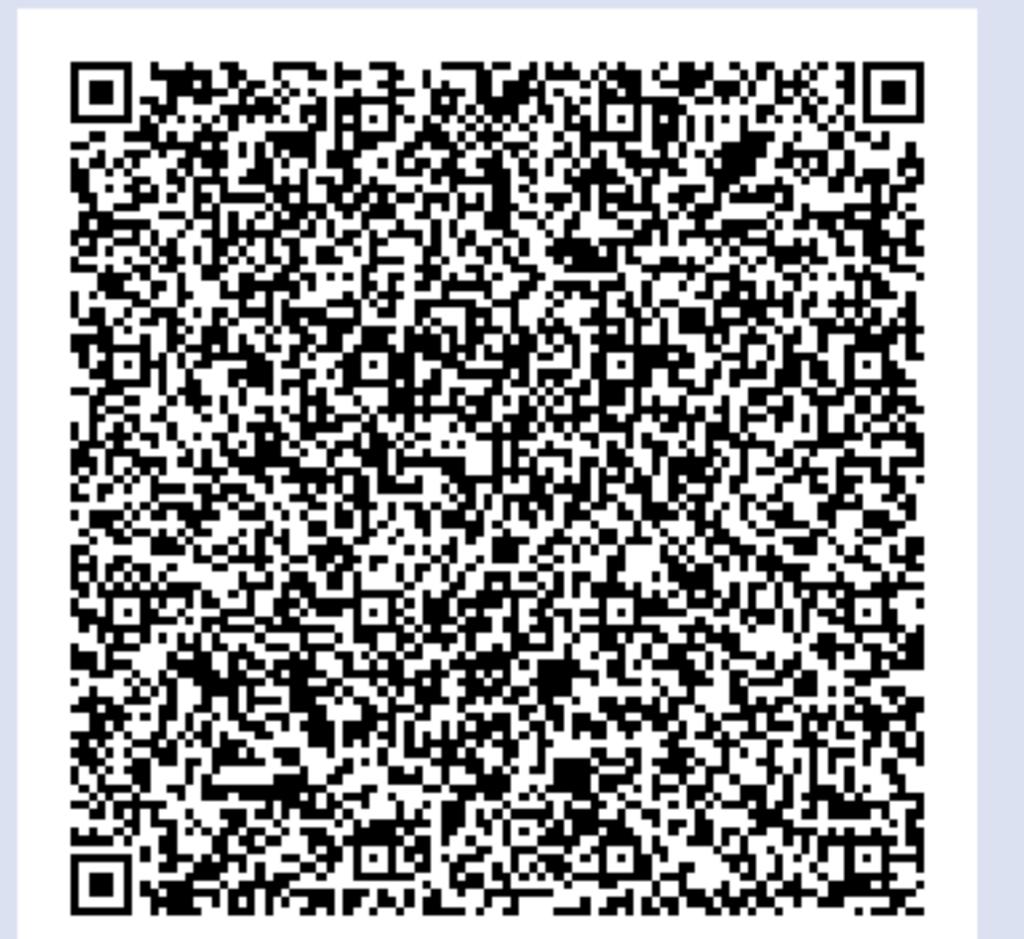
Scan the QR code with your iPad

Scanner should be present in the top menu on your iPad

2

Upload Notes on the generated link

All notes uploaded will be visible in the saved version of this session



OR

Drag and drop files or [click here to upload](#)

Files Uploaded from your computer appear here