

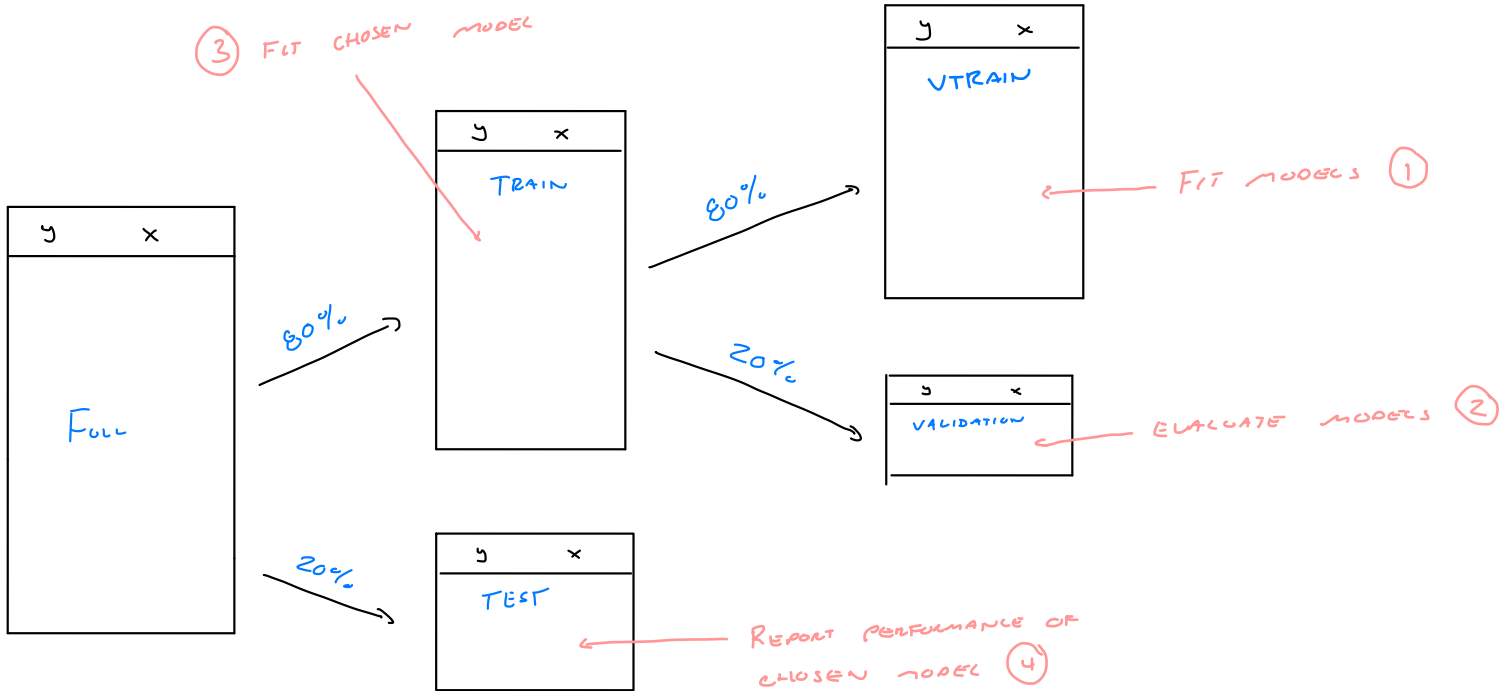
CS 307

FALL 2023

DALPIAZ

WEEK 06

# CROSS-VALIDATION



WHAT'S WRONG WITH THIS?  
TOO VARIABLE!

# A NOTE ABOUT VARIABILITY

$$X_1, \dots, X_n \quad \text{i.i.d.} \quad \begin{aligned} E[X] &= \mu \\ V[X] &= \sigma^2 \end{aligned}$$

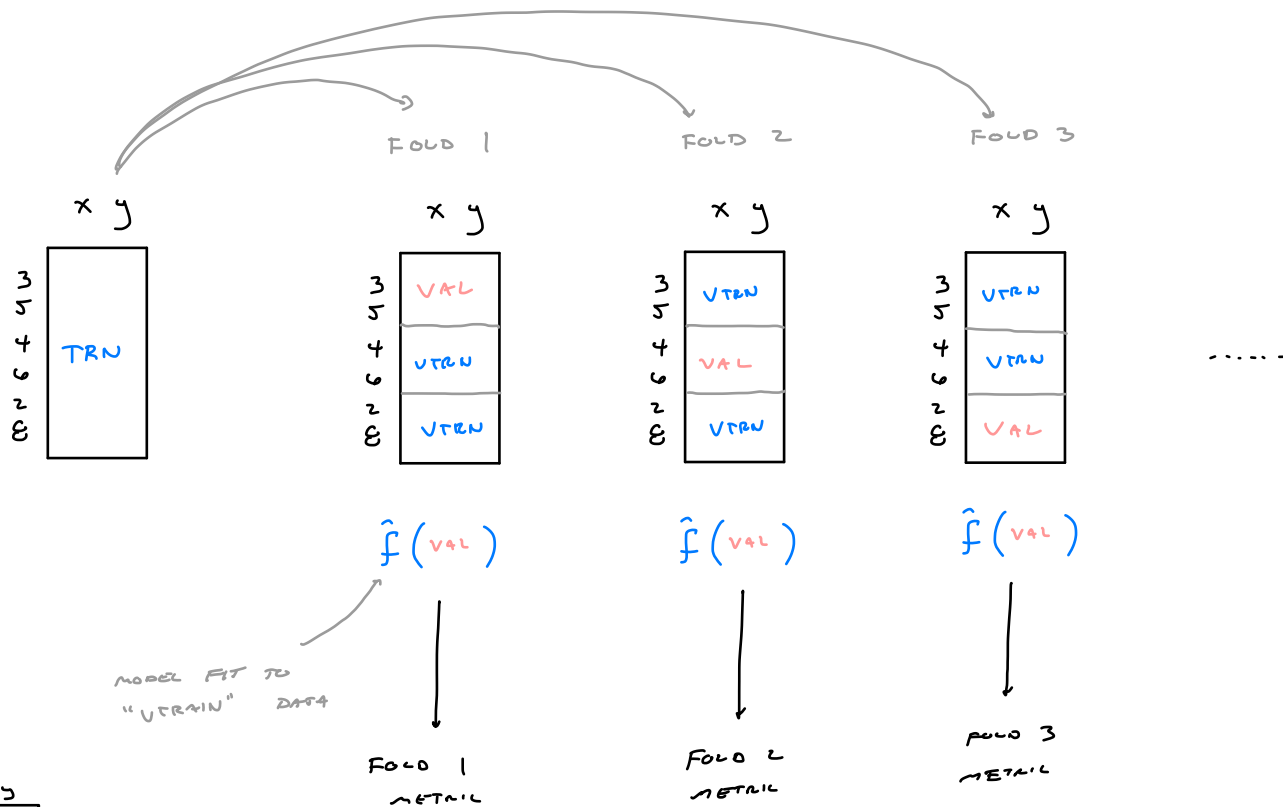
$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

$$E[\bar{X}] = \mu$$

$$V[\bar{X}] = \frac{\sigma^2}{n}$$

AVERAGING REDUCES VARIABILITY

# K-FOLD CROSS-VALIDATION



1  
7

|   | x | y |
|---|---|---|
| 1 |   |   |
| 2 |   |   |
| 3 |   |   |
| 4 |   |   |
| 5 |   |   |
| 6 |   |   |
| 7 |   |   |

TST

# CROSS-VALIDATED METRICS

RMSE  
MAE  
MAPE  
BTL

METRIC - CV<sub>K</sub>

$$= \frac{1}{K} \sum_{i=1}^K$$

H FOLDS

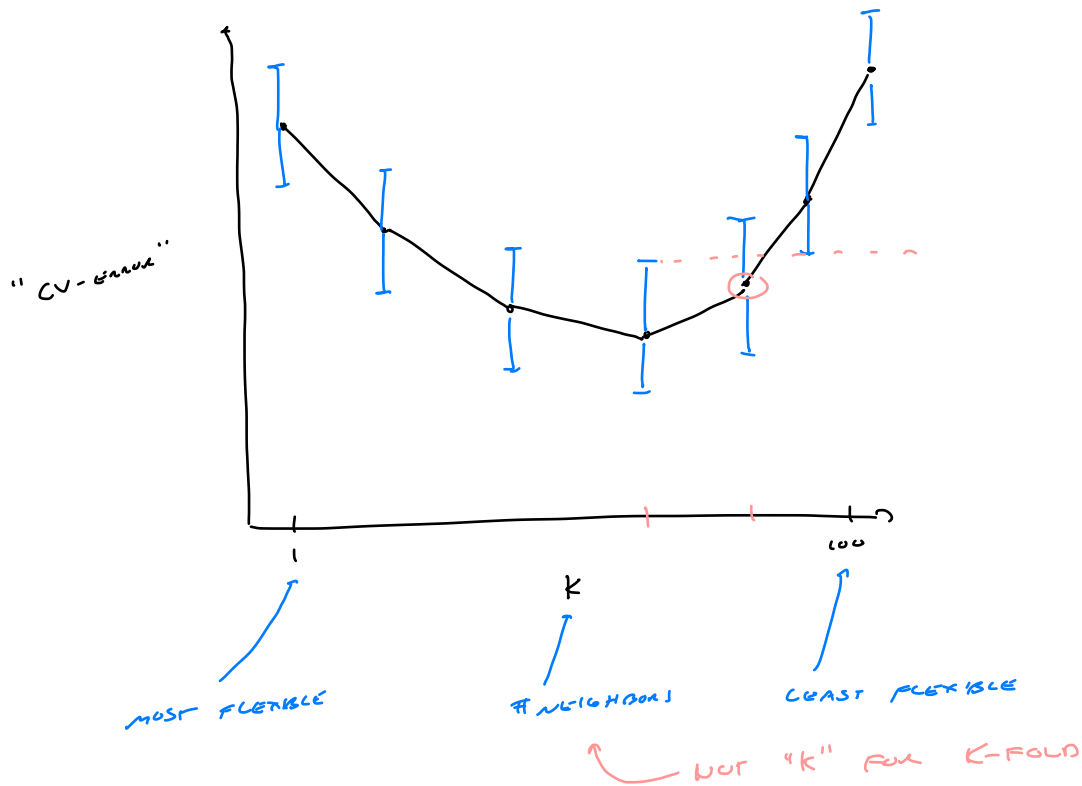
METRIC<sub>i</sub>

VALUE OF METRIC FOR FOLD i

$$SD [ \text{METRIC} - \text{CV}_K ] = \sqrt{ \frac{1}{K-1} \sum_{i=1}^K ( \text{METRIC}_i - \text{METRIC} - \text{CV}_K )^2 }$$

SAMPLE SD OF FOLD METRICS

# ONE-SE RULE



WHICH  $K$ ? FOR  $K$ -FOLD CV

Popular  $\left\{ \begin{array}{l} K = 5 \\ K = 10 \end{array} \right.$  ← LESS COMPUTING

$K = "n"$  ← "LEAVE-ONE-OUT"



## WHY CV?

- Reduces variance compared to single validation set, thus more stable for model selection!

## How CV?

- ↳ GRID SEARCH CV IN STEAD!
- ↳ NOW ONLY NEED TRAIN-TEST SPLIT
- ↳ CV HAPPENS WITHIN FULL TRAIN DATA!