Error Evaluation

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> **🔔 REMINDER**
>
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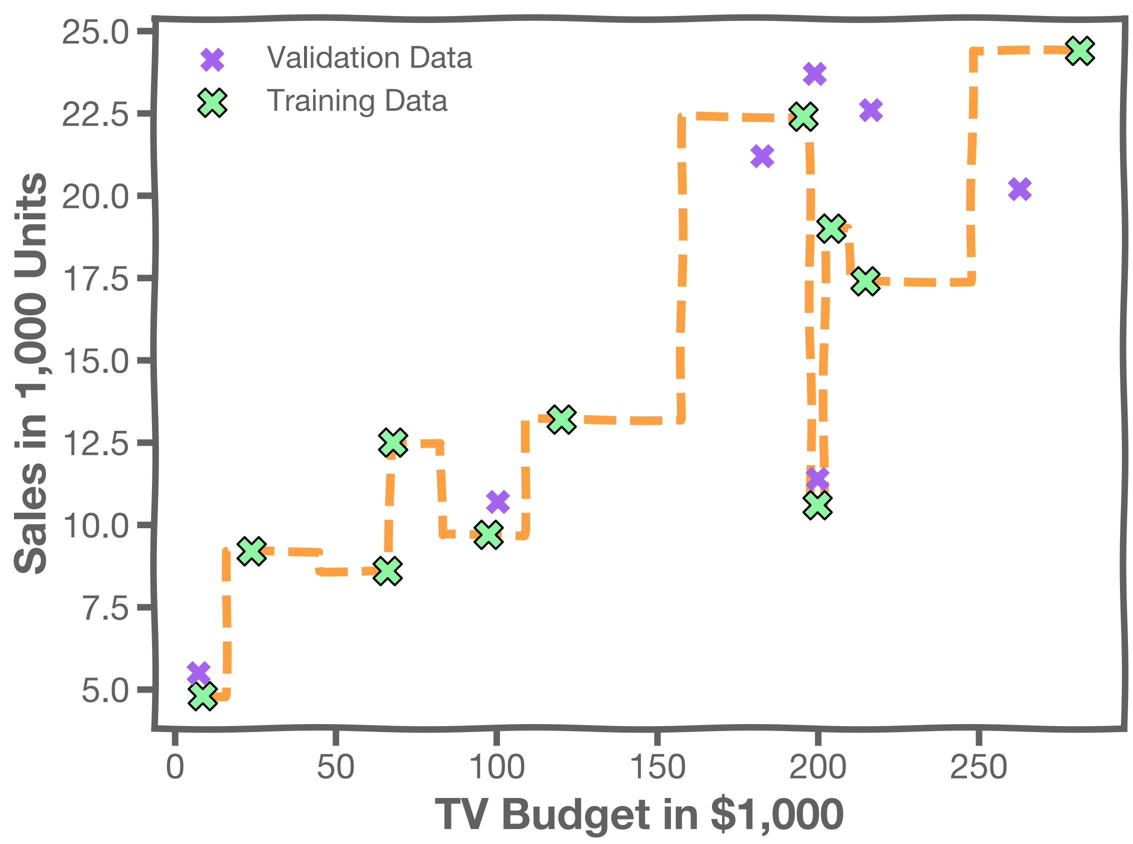
We created several different models in the example of different k-nearest neighbors, so we need a way to decide which model is best. We evaluate the error of our model by looking at how well the model is doing outside the data that is used to make the prediction.

We start with a set of data and randomly hide some of that data from our model. This is called a train-validation split. We use the visible part of the data (the training set) to estimate $\hat{y}$, and the hidden part (the validation set) to evaluate the model.

The one-neighbor model (k=1) used to make predictions $\hat{y}$ using the training set is shown on the plot. Now, we look at the data we have *not* used to make the model, the validation data shown as purple crosses.



The difference between the true value (the red cross) and the prediction is called the residual.

> **OBSERVATION ERRORS**
>
> For each observation (x_n, y_n), the absolute values of the residuals, $r_i = |y_i - \hat{y}_i|$ quantify the error at each observation.

Error Evaluation Continued

In order to quantify how well a model performs, we aggregate the errors across the data, and we call that the **loss**, **error**, or **cost function**. Cost usually refers to the total loss, while loss refers to a single training point.

A common loss function for quantitative outcomes is the **Mean Squared**

Error (MSE):

📘 Mean Squared Error (MSE)

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

⚠ Watch Out!

The MSE is by no means the only valid loss function, and it's not always the best one to use! Other choices for loss function include:

- Max Absolute Error
- Mean Absolute Error
- Mean Squared Error

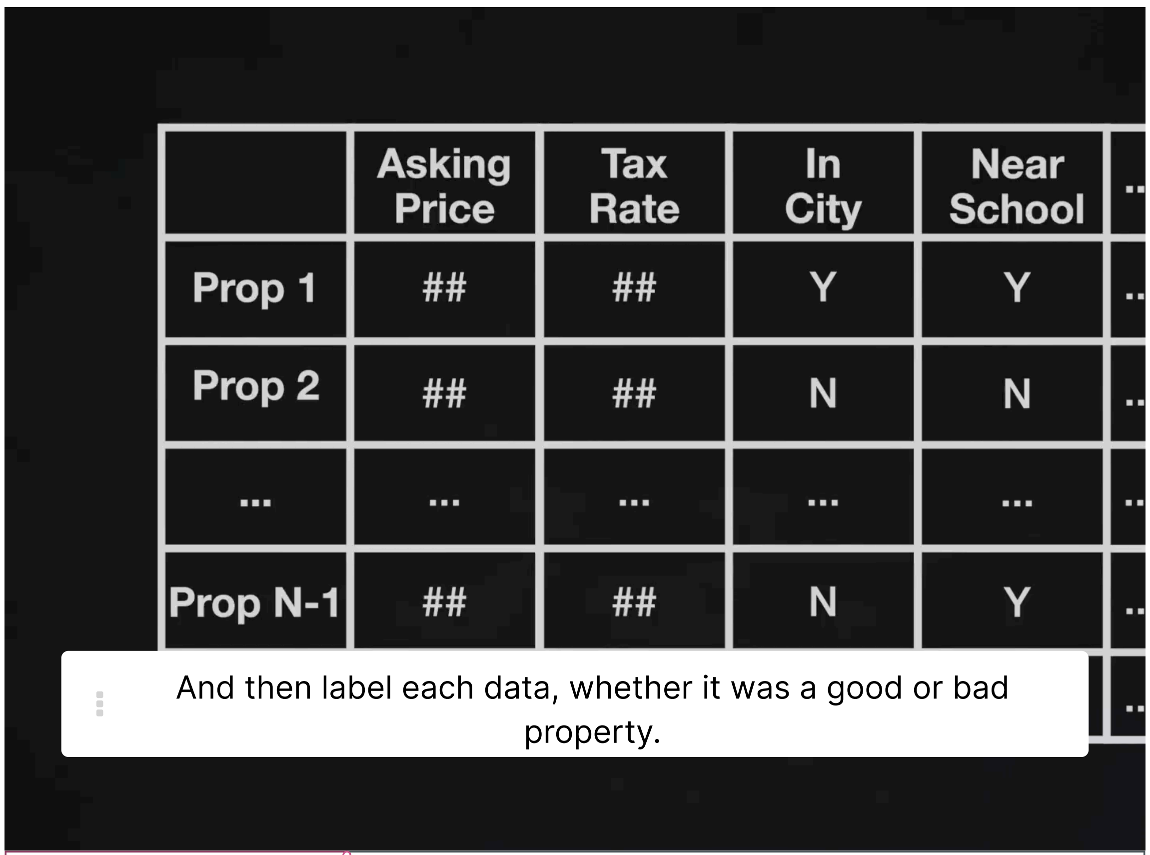
The square **R**oot of the **M**ean of the **S**quared **E**rrors (**RMSE**) is also commonly used.

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

❓ Other Kinds of Errors

Numerical error isn't the only kind you'll have to worry about. Sometimes the error is more fundamental. Sometimes we end up putting data - or the person the data represents - into the wrong category. Listen to Nabib as he talks about Type 1 and Type 2 errors.

Video



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