Model Comparison

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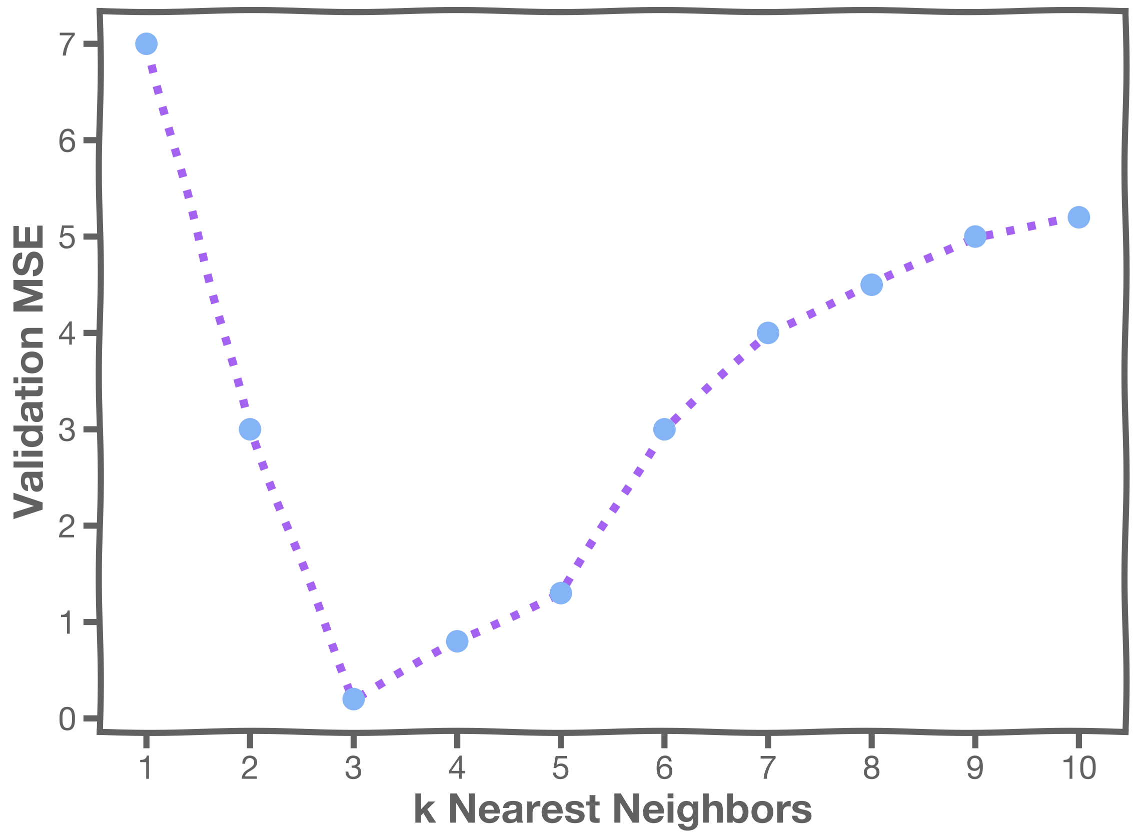
Now we have a way to measure the error of the model to do model comparison. We can do the same for all k's and compare the MSE. now since we have a measure of how well our model performs.

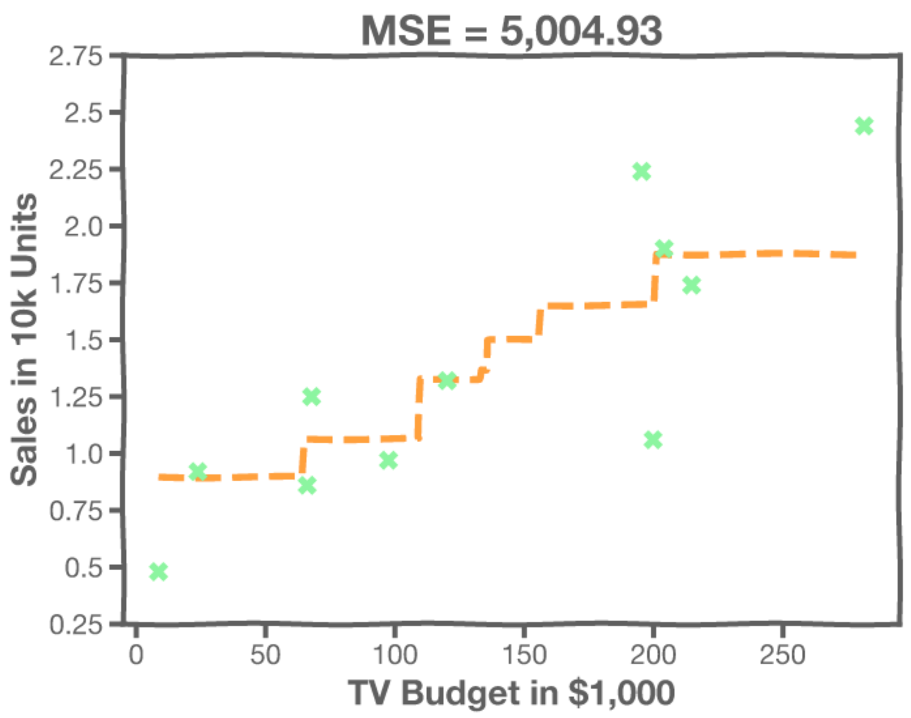
In the plot we compare the MSE for different k-nearest neighbors on the validation data. Three neighbors seems to be the best model since it has the lowest MSE. However, we should be a bit careful since it is close to `k=4`. The reason that `k=3` may be lower than `k=4` may be on the original decision how we split the data between train and validation.



Which model is the best? `k=3` seems the be the **best model**.

Model Fitness

We now have a way to compare models. But just because a model is the *best* does not mean that the model is *good*. For a subset of the data, with our best model of k=3, we calculate the MSE to be 5.0. Is that good enough? What if instead we measure sales in units of individual sales as opposed to thousand units? For k=3 the MSE is now 5,004.93. Is the MSE now good enough?



In order to answer this question we create a scale to compare our model to a very bad model and a very good model.

We will use the simplest model, the average or naïve model for comparison: $\hat{y} = \frac{1}{n}\sum_i y_i$ is the worst possible model we can do that still makes sense.

We will say that $\hat{y}_i = y_i$ is the best possible model, when the prediction is

We will say that $\hat{y}_i = y_i$, is the best possible model, when the prediction is identical to the true value.

R-squared

We put that into a scale from 0 to 1 by creating a new quantity R-squared.

$$\hat{R}^2 = 1 - \frac{\sum_i (\hat{y}_i - y_i)^2}{\sum_i (\bar{y} - y_i)^2}$$

> **⚠ WATCH OUT!**
>
> Though it is called R-squared, it is not just the square of R. You *can* get negative R-squared values.

- If our model is as good as the mean value, $\bar{y}$, then R-squared=0
- If our model is perfect, then R-squared=1
- R^2 can be negative if the model is worse than the average. This can happen when we evaluate the model on the validation set.

> **NOT WHAT YOU EXPECTED?**
>
> What happens if your R-squared value is low, but you expected there to be a connection between the variables you're measuring? Sometimes just looking at a single number isn't enough. Check out Angela's video below for an example.

Video

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Video

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