LINEAR REGRESSION

Review

WHAT WILL YOU LEARN/REVIEW

- Reviewing the basic idea behind linear regression
- Learning how to measure predictive quality with Mean Square Error (\(MSE\)).
- Calculating optimal OLS regression parameters using `tidymodels`
- Distinguish between unfitted and fitted models
- How to interpret the OLS regression parameters and their significance
- Using metrics to evaluate prediction quality on the testing

LOADING THE LIBRARIES AND THE DATA

▶ Code

```
     Price Sqft Bedrooms Condition
1 523633.4 2040        4         3
2 530960.7 2120        4         3
3 523466.8 2130        4         4
4 759747.7 3330        4         3
5 546377.8 2440        4         3
6 186536.6  900        3         4
```

SPLITTING IN TRAINING AND TESTING DATA:

```r
set.seed(Seed)
Split7030=initial_split(DataHouses,prop=0.7, strata = Price)
DataTrain=training(Split7030)
DataTest=testing(Split7030)
```

HOW MUCH IS A HOUSE WORTH IN KING COUNTY?

A house with average properties should be predicted with an average price!

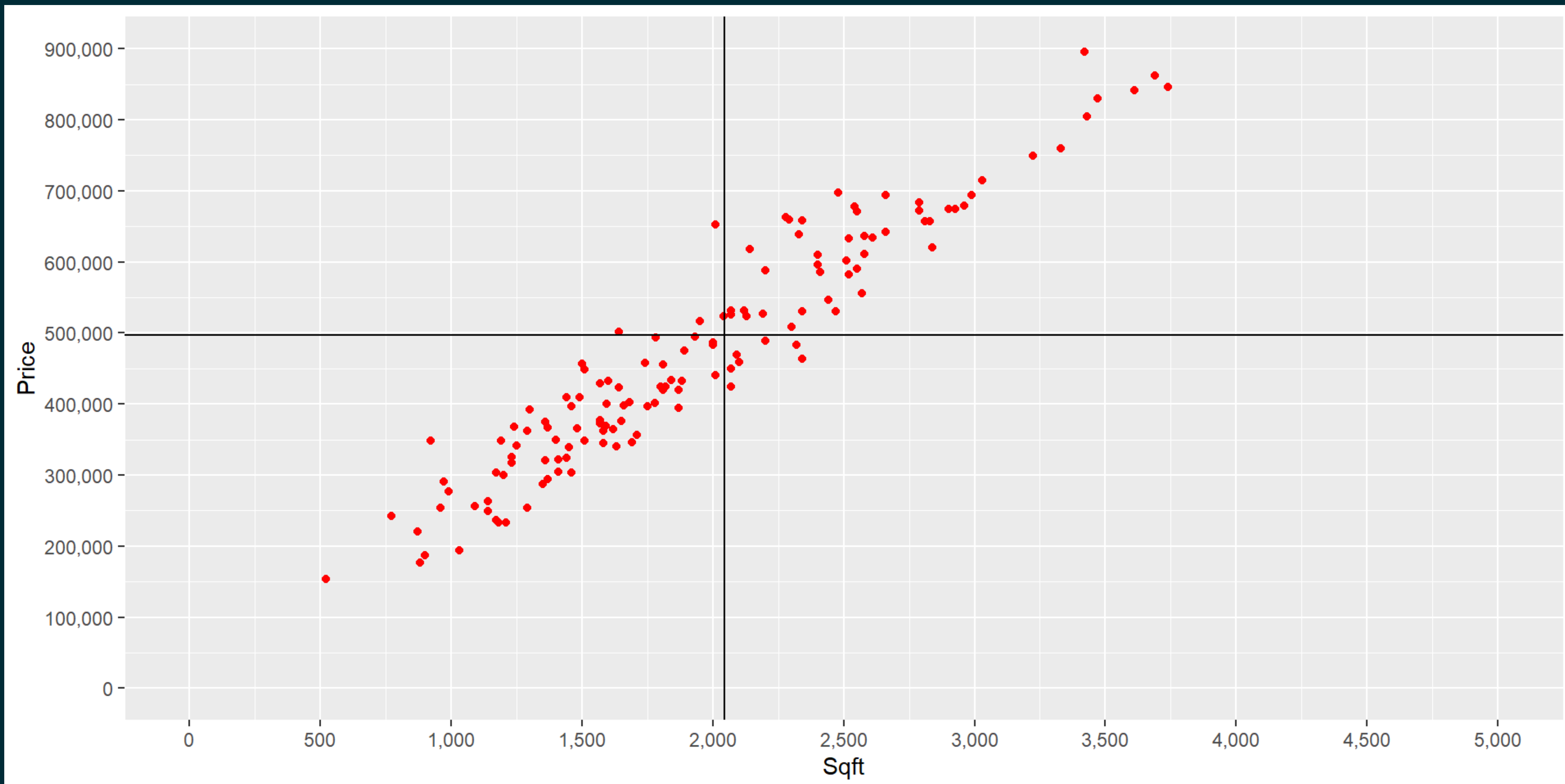
▶ Code

```
The mean square footage of a house in King county is: 2044.319
```

▶ Code

```
The mean price of a house in King county is: 497414.9
```

PREDICTING THE PRICE OF AN AVERAGE SIZED HOUSE AS THE AVERAGE OF ALL HOUSE PRICES



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HOW TO MEASURE PREDICTION QUALITY WITH THE MEAN SQUARED ERROR (MSE)

$$\begin{eqnarray*} MSE & = & \frac{1}{N} \sum_{i=1}^{N}(\widehat{y}_{i}-y_{i})^{2} \\ & \Longleftrightarrow& \\ MSE & = & \frac{1}{N} \sum_{i=1}^{N} (\underbrace{\overbrace{\beta_{1}x_{i}+\beta_2}^{\mbox{Prediction i}}-y_i}_{\mbox{Error i}})^2 \end{eqnarray*}$$

Note, when the data are given (i.e., x_i and y_i are given), the MSE depends only on the choice of β_1 and β_2 »

INCLUDING SQFT AS DETERMINAT OF PRICE

PREPARING THE DATA

Blueprint for the data:

```
RecipeHouses=recipe(Price~Sqft, data=DataTrain)
```

CHOOSING THE MODEL BLUEPRINT

Blueprint for the model:

```
ModelDesignOLS=linear_reg() |>
            set_engine("lm") |>
            set_mode("regression")
```

HOW DOES THE UNFITTED MODEL LOOKS LIKE?

$$\underbrace{Price}_y=\underbrace{\beta_1}_m \underbrace{Sqft}_x + \underbrace{\beta_0}_b$$

USING A WORKFLOW TO FIT THE MODEL TO THE DATA (FINDING THE OPTIMAL \(\BETA_1\) AND \(\BETA_2\) VALUES

\[\underbrace{Price}_y=\underbrace{\beta_1}_m \underbrace{Sqft}_x + \underbrace{\beta_0}_b \]

```
WFModelHouses=workflow() |>
               add_recipe(RecipeHouses) |>
               add_model(ModelDesignOLS) |>
               fit(DataTrain)
```

UNFITTED MODEL VS FITTED WORKFLOW MODEL

INTERPRETATION AND SIGNIFICANCE

{.smaller}

Unfitted Model: \[\underbrace{Price}_y=\underbrace{\beta_1}_m \underbrace{Sqft}_x + \underbrace{\beta_0}_b \]

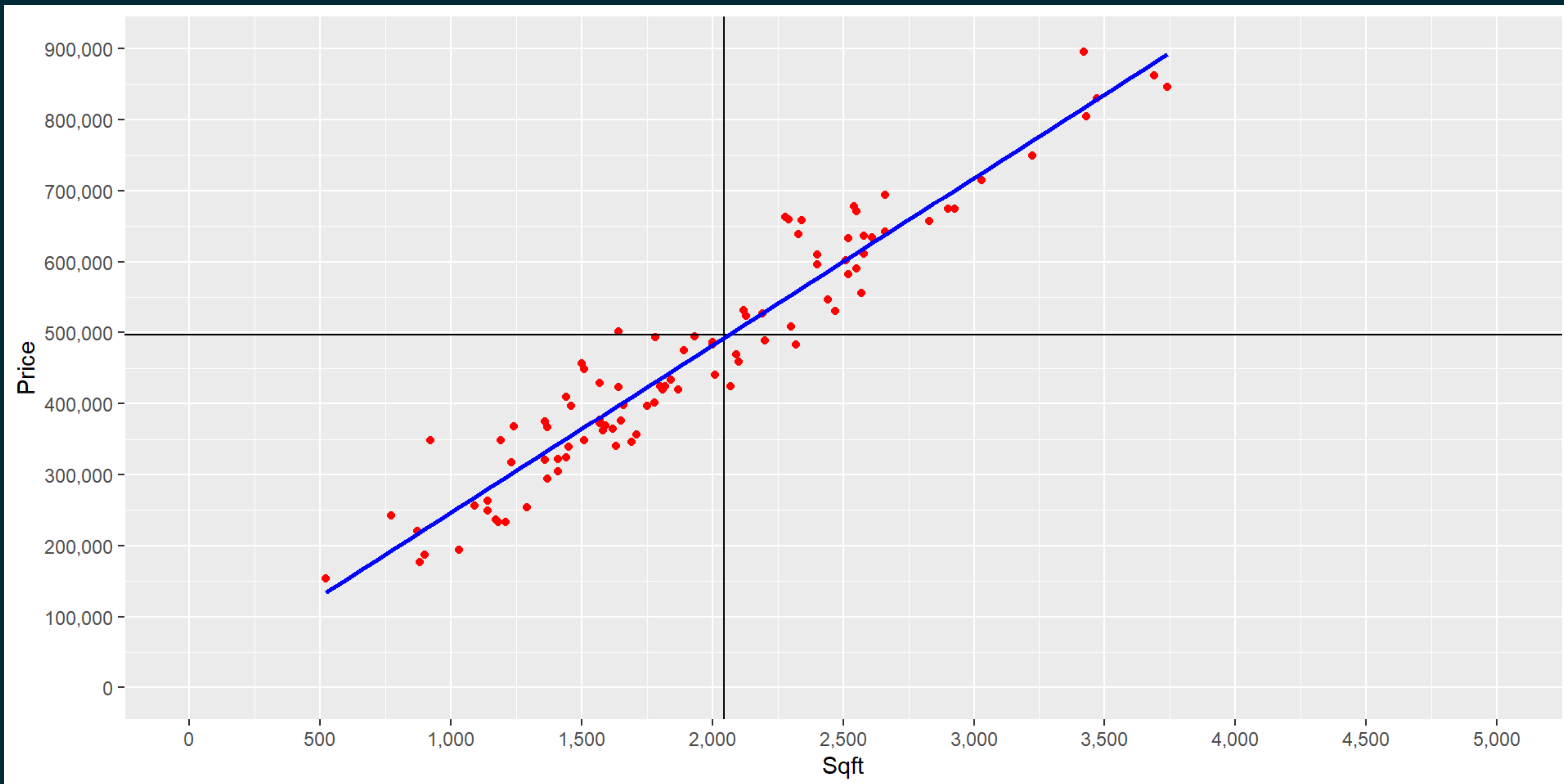
▶ Code

```
# A tibble: 2 × 5
  term        estimate std.error statistic  p.value
  <chr>          <dbl>     <dbl>     <dbl>    <dbl>
1 (Intercept)    6584.  12191.       0.540 5.90e- 1
2 Sqft            238.       5.47   43.5   6.43e-66
```

Fitted Model: \[\underbrace{Price}_y=\underbrace{238}_m \cdot\underbrace{Sqft}_x + \underbrace{6584}_b \]

Predict the price for a house with 1,000 sqft and send it to me in a private chat!

HOW DOES THE FITTED MODEL THAT CONSIDERS SQFT IMPROVES THE PREDICTION COMPARED TO A SIMPLE AVERAGE



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EVALUATING PREDICTIVE QUALITY WITH THE TESTING DATASET

```r
DataTestWithPred=augment(WFModelHouses, new_data=DataTest)
metrics(DataTestWithPred, truth=Price, estimate=.pred)
```

```
# A tibble: 3 × 3
  .metric .estimator .estimate
  <chr>   <chr>          <dbl>
1 rmse    standard   50915.
2 rsq     standard       0.923
3 mae     standard   39748.
```

PROJECT: ANALYSIS WITH ALL VARIABLES

```r
library(rio)
library(janitor)
library(tidyverse)
DataHouses=import("https://ai.lange-analytics.com/data/HousingData.csv") |>
            clean_names("upper_camel") |>
            select(Price,Sqft=SqftLiving,Bedrooms,Condition)
```

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