# Forecasting Avocado Prices

Avocado King can use data to optimize profits

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# The problem

## Company

Avocado King , a major distributor of avocados across the USA

## Context

Avocado **prices fluctuate** based on a variety of factors

Avocado King stores historical **sales and price data**

Google provides historical **search data**

## Problem statement

There is a need to **forecast avocado prices** to enable company-wide financial planning

# Challenges deep-dive

## Understand data

Through data visualization, we can better **see relationships** in the data and develop analytical approach

## Prepare data

The data given has a unique key: **[date, region, type]**

- Data must be **cleaned** and **normalized** carefully with key in mind

## Model prices

Utilize sound statistical analyses and **machine learning** to model prices

- Random forest regression
- Linear regression

# Solution

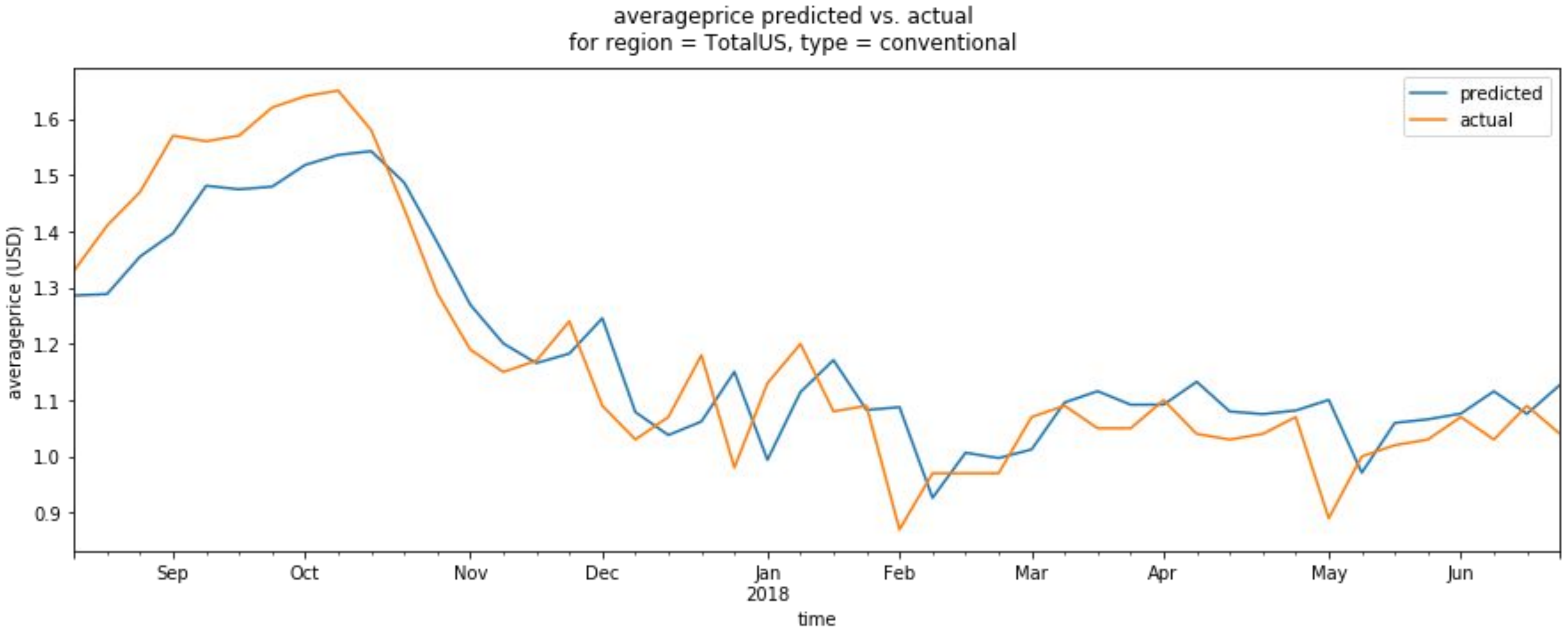
Linear Regression

On average, the selected model predicts avocado prices **within 11 cents of the true value**.

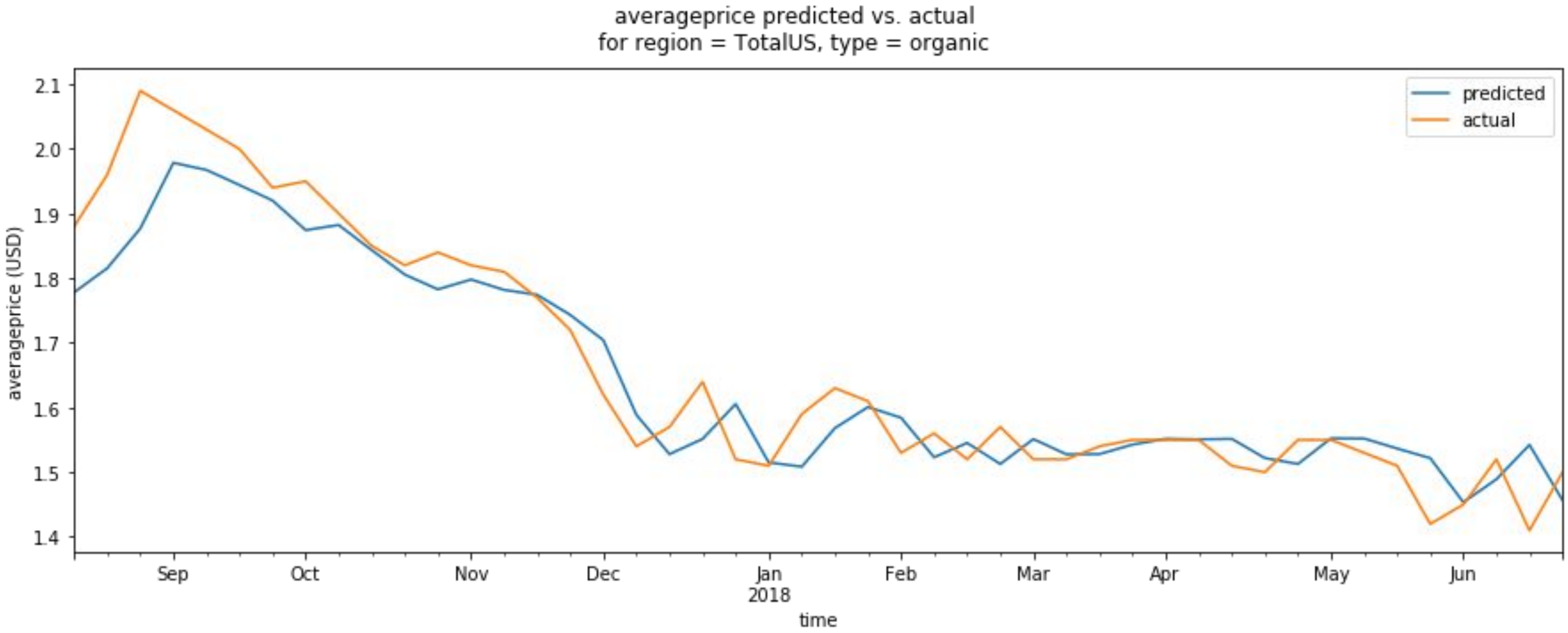
# 84%

of variation seen in price is explained by the selected model

# Model performance



# Model performance



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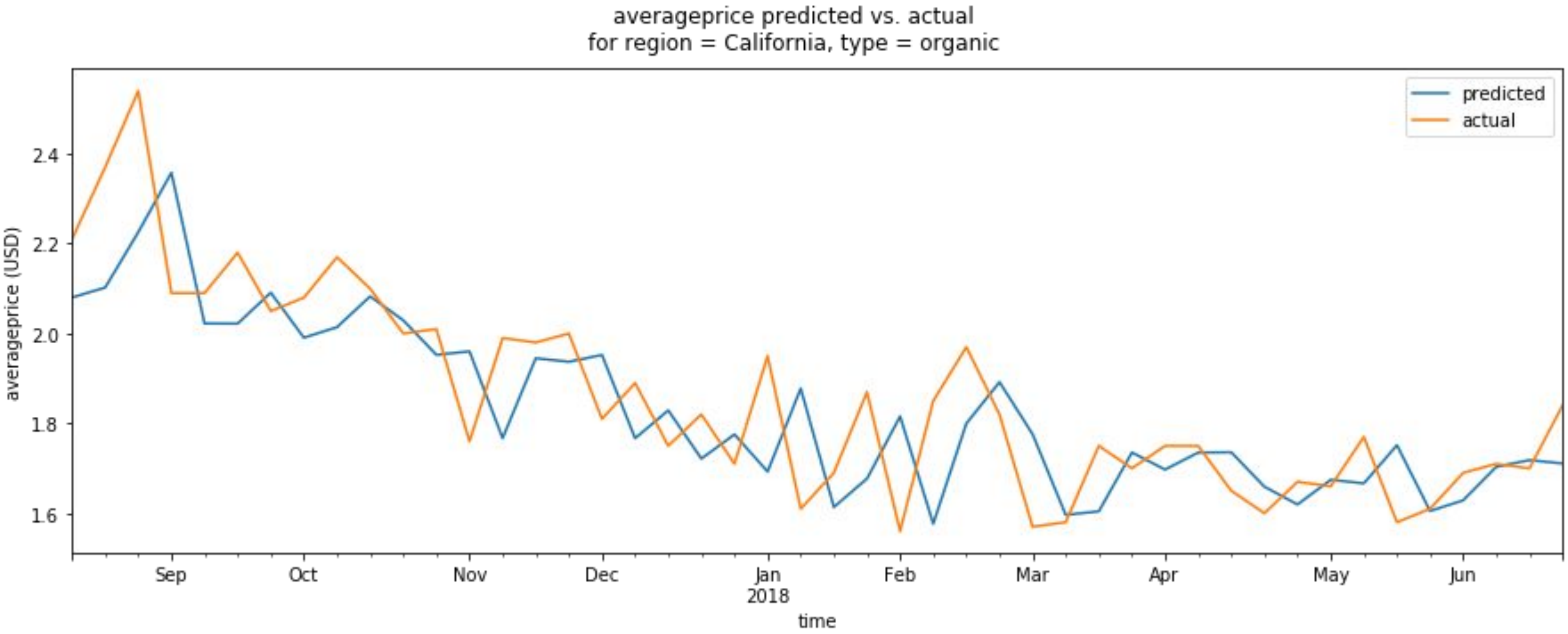

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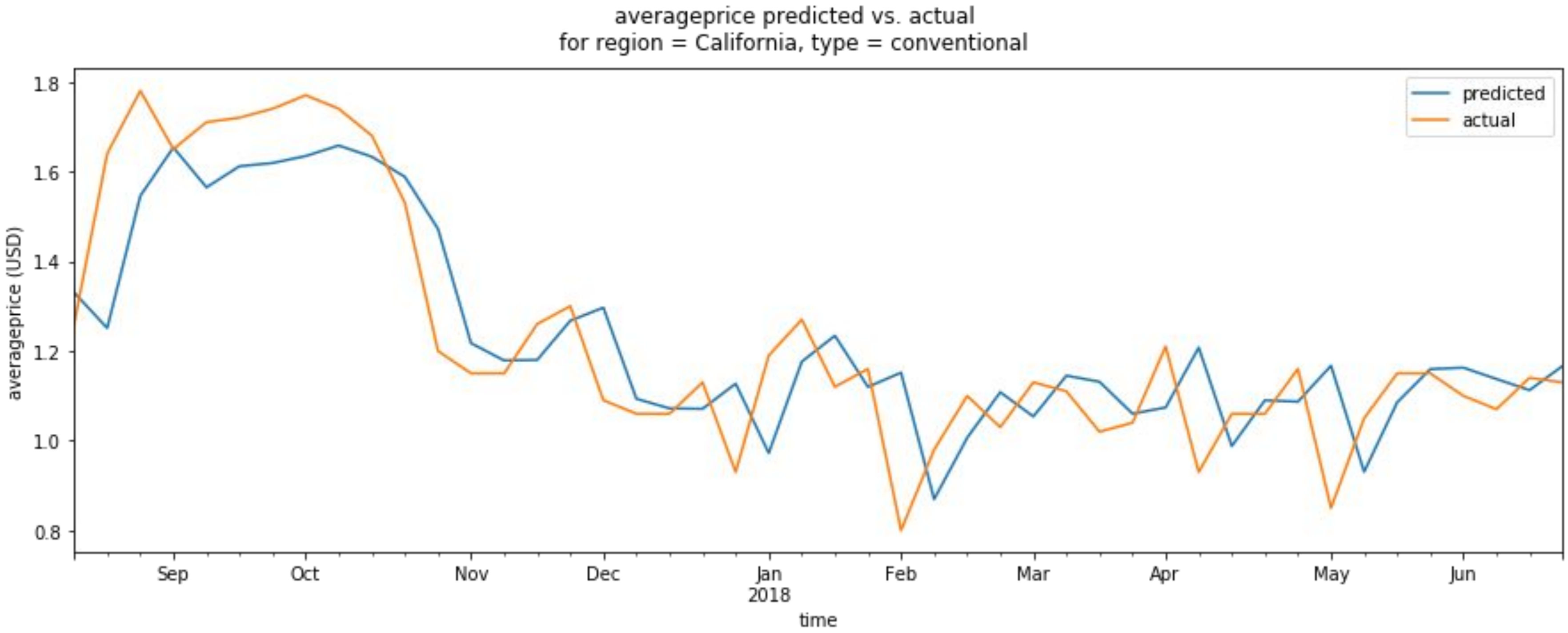

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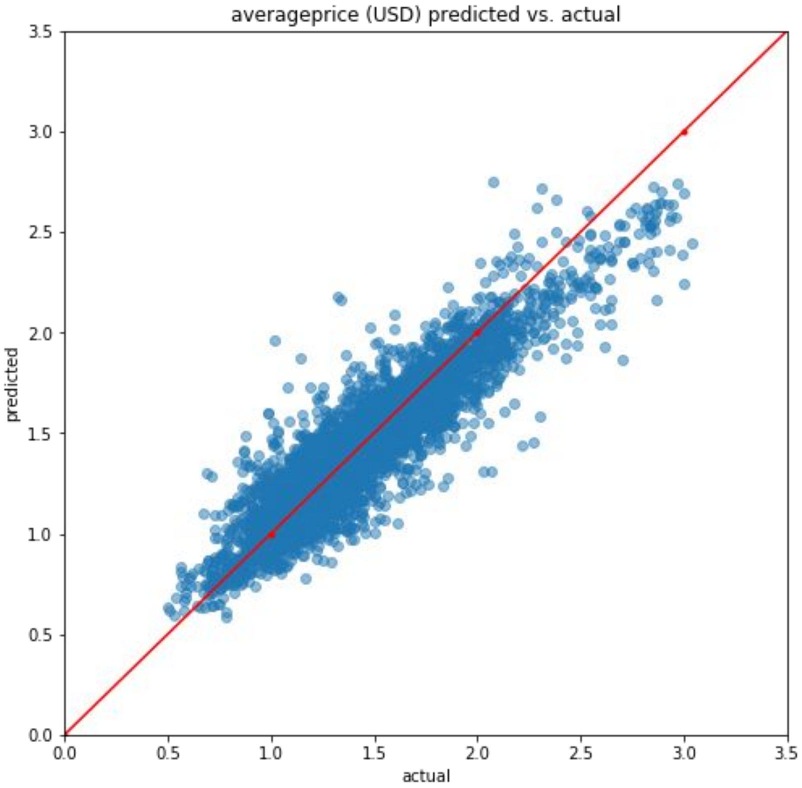

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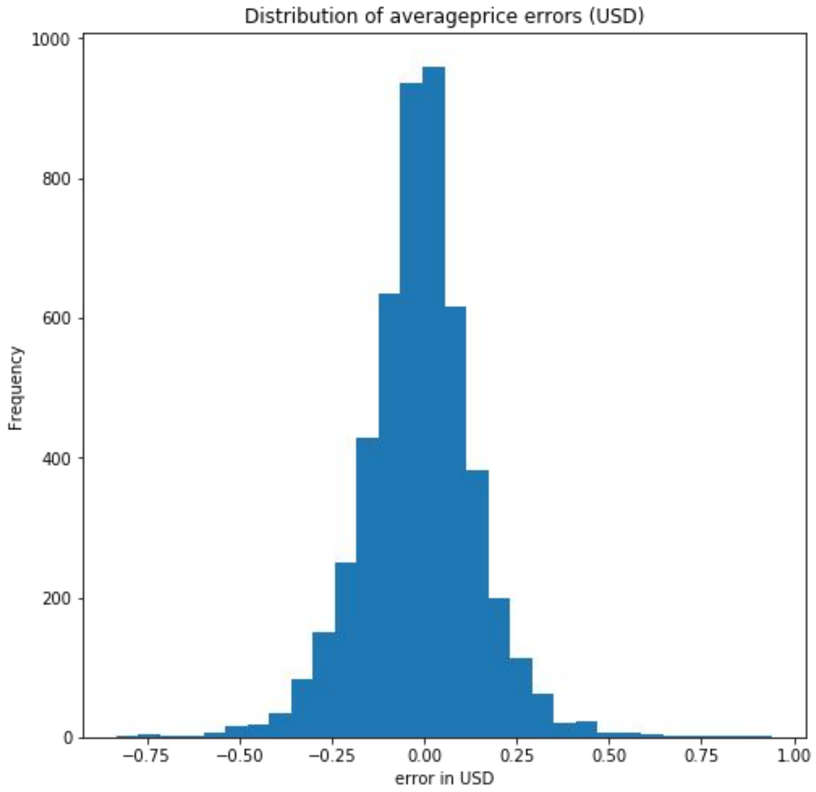
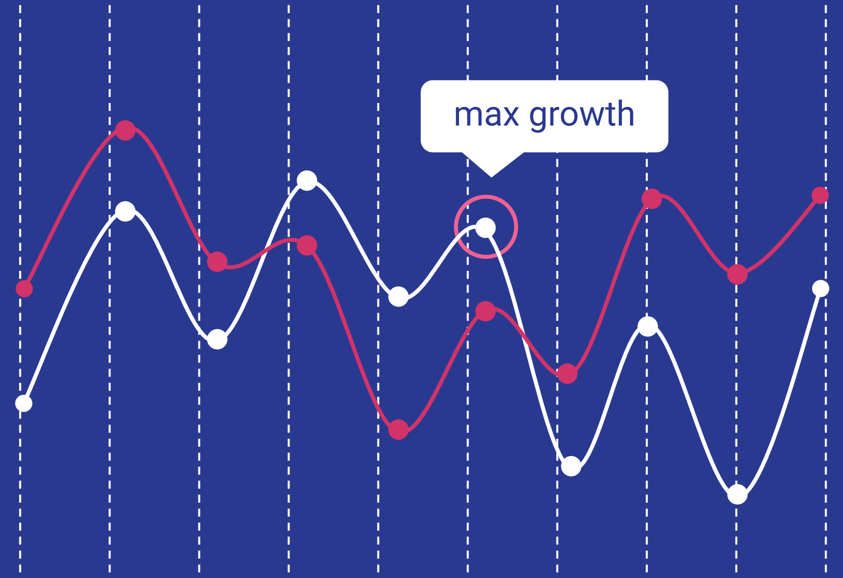


# Impact

Forecast prices => **Plan ahead**
=> **Optimize profits**
=> **Maximize growth**



# Next steps

This proof of concept can be expanded upon:

- Higher accuracy
- Forecasting weekly, monthly, quarterly, yearly
- Forecasting volume sold

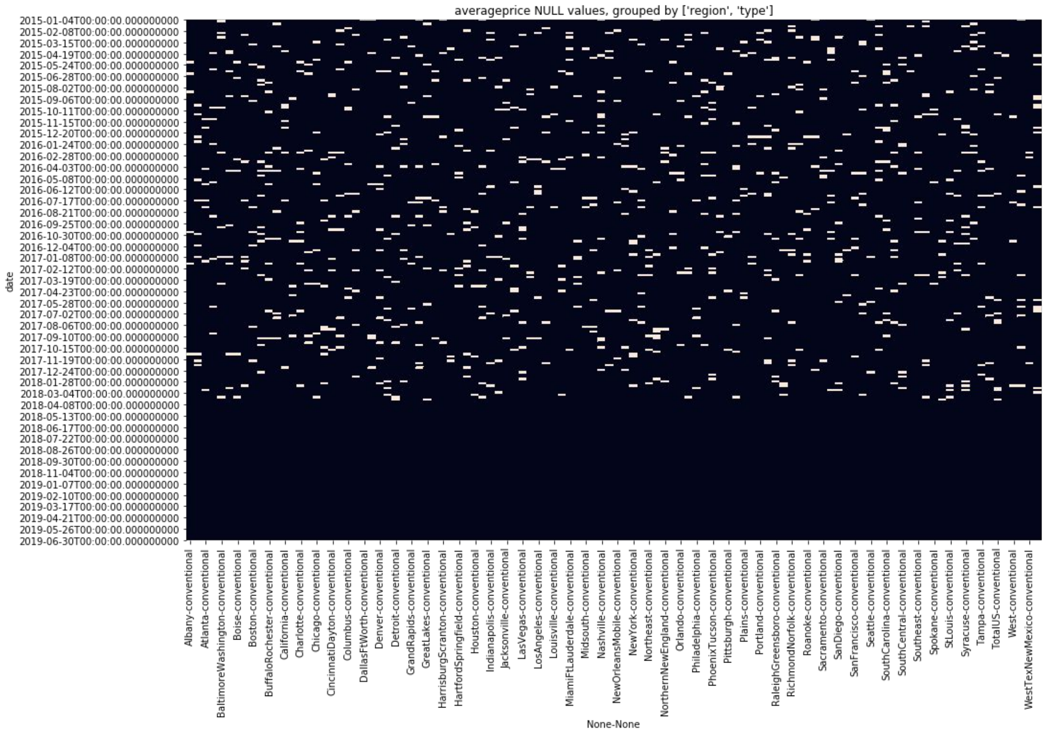
# Technical details

**Data cleaning**

There is a unique key for this dataset: [date, region, type]. We ensured no data was missing:

1. Check for **extra dates** (out of expected weekly sequence)
2. Check for **missing dates** (based on expected weekly sequence)
3. Use **forwardfill** to fill nulls
4. Use **backwardfill** to fill remaining nulls

Each unique key combination was visualized:

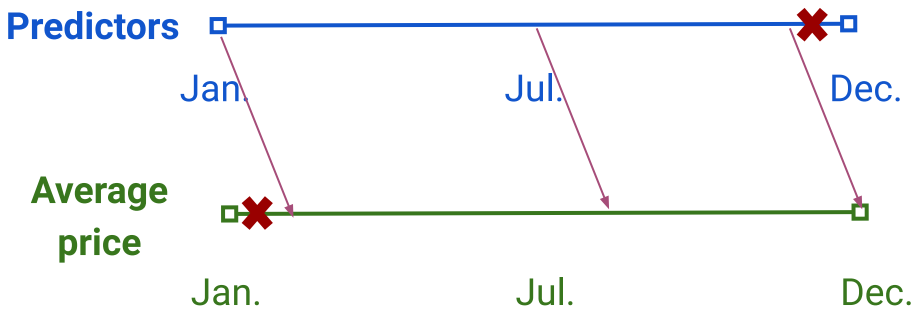


# Technical details

**Time shifting**

In forecasting, we use values from this week predict next week's values. So we shifted the data accordingly.

1. Drop the latest date in x
   a. (since it doesn't have an associated future y at *t*+1)
2. Add 7 days to each date in x
3. Drop the earliest date in y
   a. (since it doesn't have a corresponding past x at *t*-1)
4. Join the x (*t*-1) and y (*t*) dfs on the unique key [date, region, type]

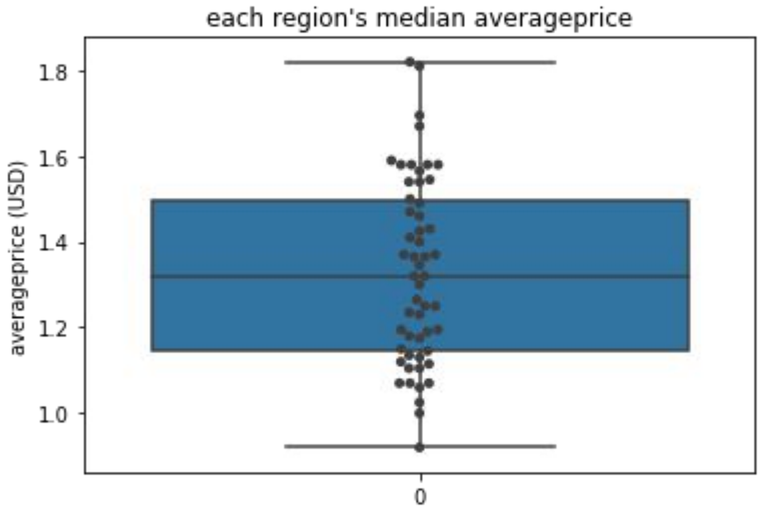


# Technical details

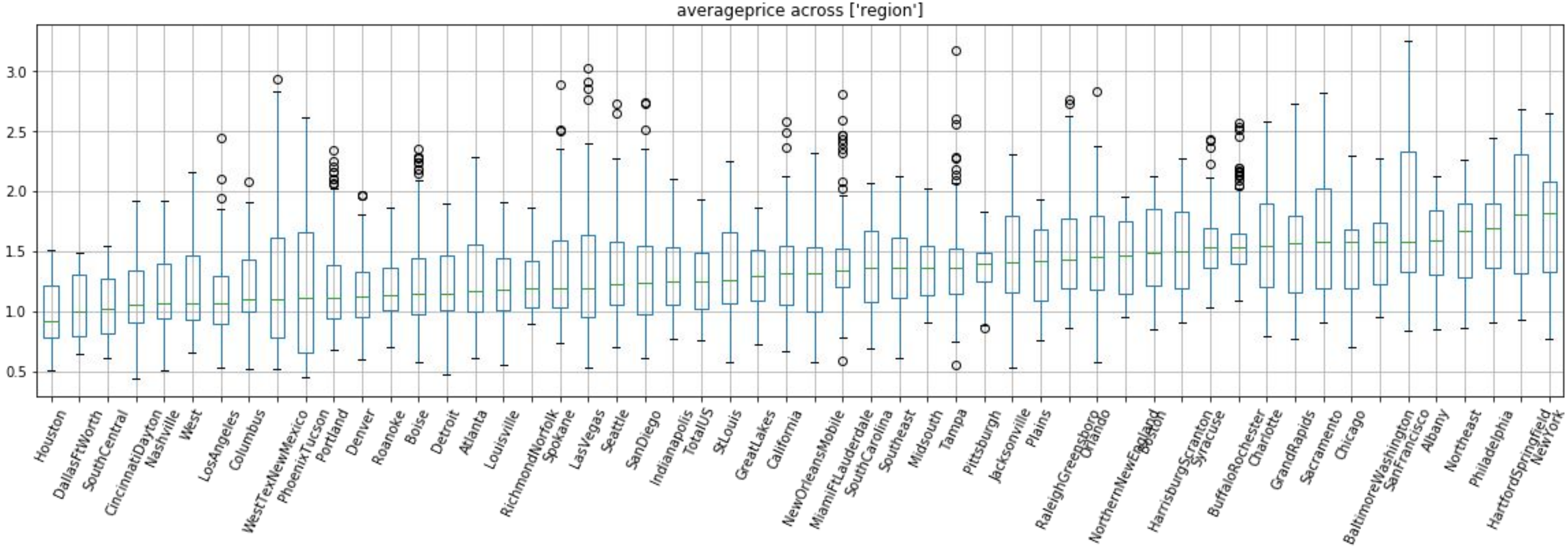
**The data**

All predictive variables were shifted 1 week back to enable forecasting 1 week ahead.

- Average price (per avocado, USD)
- Region group
- Total volume (avocados sold)
- Total bags (bags sold)
- “Avocado recipe” (google search)
- Season (spring, summer, fall, winter)
- Type (conventional, organic)



# Technical details

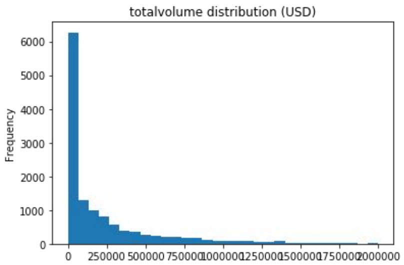


# Technical details

**Normalization**

All numeric predictive variables were **tested** via several normalization methods, seeking to best preserve the original distribution

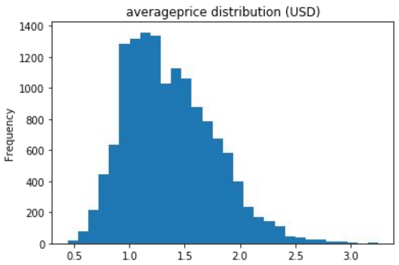
- Z-score
- Methods for preserving skewed distributions (e.g. Pareto):
    - MinMax
    - Log + MinMax
    - Cube Root + MinMax




Z-score normalized:

- Total volume
- Total bags
- “Avocado recipe” (google search)

Left average price on its original scale to preserve distribution. Original was scale not big enough to overpower other predictors.



# Technical details

**Train / Validation / Test split**

Since this is time series data, **we want full years (with all their seasonal variations) to exist** in the train, validation, and test set.

- training set:
  - Jan 2015 - July 2017
- validation set:
  - August 2017 - July 2018
- test set:
  - August 2018 - July 2019

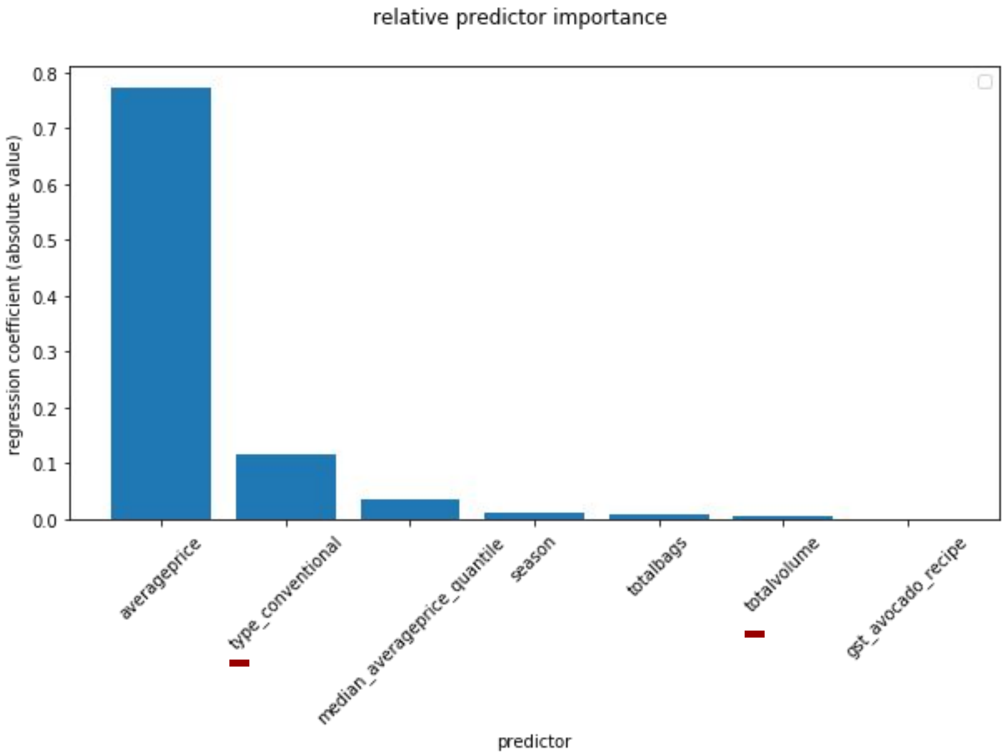
- training set:
  - 58%
- validation set:
  - 21%
- test set:
  - 21%

# Technical details

**Predictor importance**

Based on the model, the rank of importance is:

- Average price (per avocado, USD)
- Type (conventional, organic)
- Region group (median_averageprice_quantile)
- Season (spring, summer, fall, winter)
- Total bags (bags sold)
- Total volume (avocados sold)
- “Avocado recipe” (google search)



# Technical details

**Error Metric**

Mean absolute error was used when evaluating model performance:

- Enables us to intuitively understand how accurate our predictions will be, on average.
- MAE = 0.11
    - “On average, the model predicts avocado prices within 11 cents of the true value.”