Flight price prediction in the USA

Group 18 Google transmission
111550114 趙堉安 111550060 劉千慈 111550074 陳映竹

01

Introduction

Introduction

- ## Overview

  Developing an model that can predict airline ticket prices between 16 airports in the USA

- ## Motivation

  1. Evaluating the going rate of economy classes in all airline.
  2. Planning a surprise visit to our friend.

Introduction

Using airport ATL to be an example:

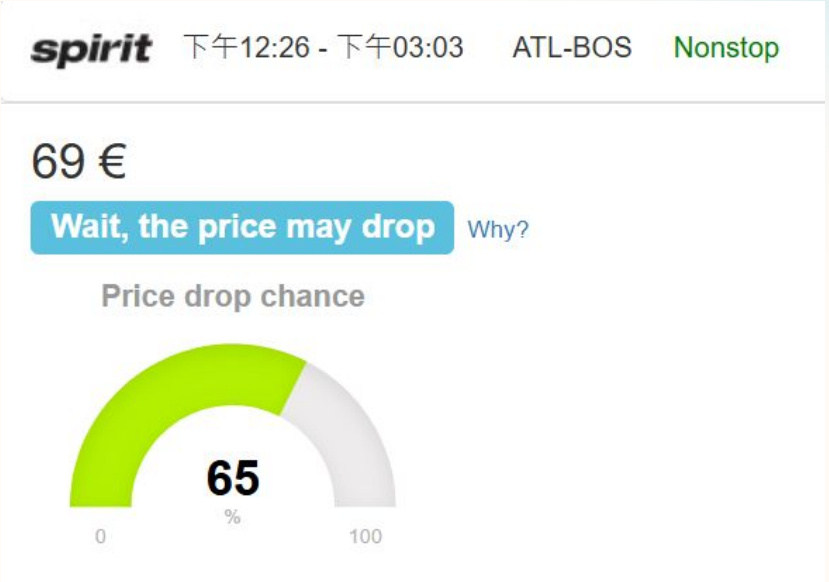
02

Related work

Airfare prediction websites

- Most of them predict the price trend in the coming weeks or whether to buy the tickets

- The difference is that we focus on the current going rate



Papers about flight price prediction

- Most papers include all classes of tickets and use a numerous dataset to predict flight price.

- We want to train our model with the following three characters:

    1. Only using the data of economy class.
    2. Using a smaller dataset with limit time interval.

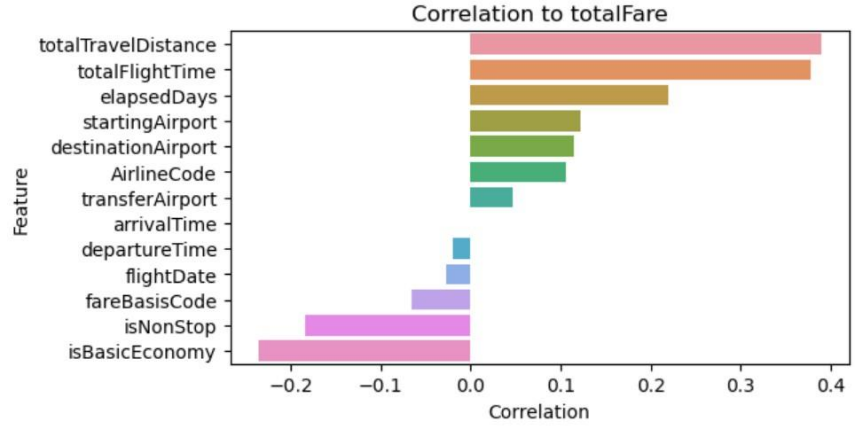
03

Dataset/Platform

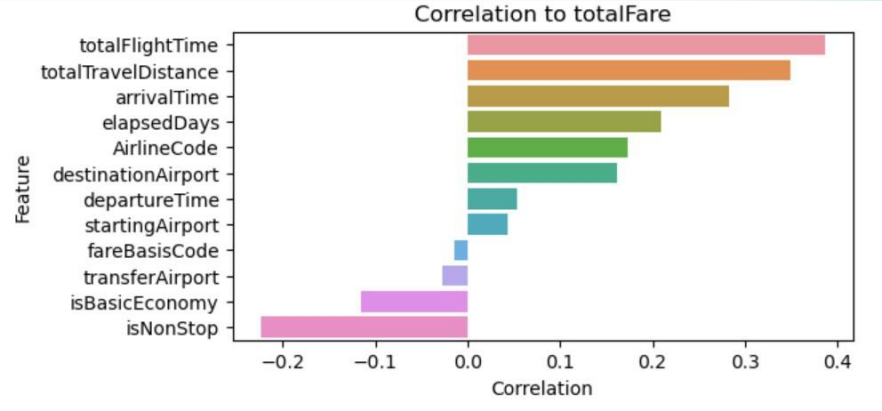
Dataset/Platform

- **Fetching the dataset from Kaggle**
- **Preprocessing the data**
    1. Selecting the flights on 2022-04-17 and economy class.
        - size: 6000000 -> 80000 -> 7000 rows
    2. Keeping the effective features.
        - Ex: total flight time, travel distance...
- **Separating the data into train and test. (4:1)**

Initial data analysis



80000-row dataset



7000-row dataset

04

Baseline

Baseline

- **Decision tree algorithm**
- Using a single tree to sort all data points into several sections.
- STEP:
  - **Initialization and split into groups**
    - Calculate the loss and find the best splitting point with MSE.
    - Split the dataset into at most min_samples_split groups.
  - **Iterative the process above.**
    - It will continue until the depth is equal to max_depth.
  - **Obtaining a tree with prediction.**
    - Data will be separated into several leaves and each leaf will represent the prediction under that specific situation.

Baseline

- **Decision tree algorithm**

- Reason:
  1. Complex non-linear relationships between features in data.
  2. It is suitable in classification and regression problems.

- Limitation:
  1. Risk of overfitting
  2. It can’t properly handle high dimension data or data with lots of missing.

05

Main Approach

Input & Output

Input

1. **Transfer the non-number data to number with pandas**
2. **features in dataset**:

   total distance, total flight time, elapsed day, destination, airline, transfer airport, arrival time, departure time, flight date, fare basis code, nonstop and basic economy
3. **Separate two sub dataset for training and testing**

Output

- The predicted price of flight

Method

1. Random Forest

- It is constructed by n_estimator random trees.
- STEP:
  - **Selecting a dataset randomly from the original dataset**
    - size will be the same as the original one
    - and the data can be repeated
  - **Applying decision tree method & construct a forest.**
    - In our case, the forest contains 50 trees.
  - **obtaining the final result of prediction**
    - we take the average of each prediction result of the trees

Method

2. Gradient boosting

- Combining simple models to build a strong model.
- STEP:
  - **Getting initial loss value.**
    - loss value between current result and the real value will be calculated.
  - **Iterative training.**
    - take part of loss value to update and optimize the prediction.
    - Training model with n_estimator times
  - **Updating the prediction every round.**

06

Evaluation Metric

Evaluation Metric

1. **Quantitative**
    - RMSE
    - R^2 score
    - Accuracy
2. **Qualitative**
    - It is not suitable to use qualitative evaluation metric, since our implementation is totally constructed by numerical value.

Quantitative

1. RMSE

Measure the average difference between the model's predicted values and the actual values.

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

2. R^2 score

Measure the extent to which the model explains the variance in the data.

$$R^2 = 1 - \frac{SS_{RES}}{SS_{TOT}} = 1 - \frac{\sum_i (y_i - \hat{y}_i)^2}{\sum_i (y_i - \overline{y})^2}$$

Quantitative

3. Accuracy

it can be used to measure the model's performance in predicting the correct interval.

we compare the prediction result to the original total fare.
If the error is like above, we assume it is accurate and calculate the whole accuracy.

07

Results & Analysis

Result & analysis

- Decision tree:

```
RMSE: 154.64495591166593
R² score: 0.493959969078051 95
Accuracy: 53.806781829814454 %
```

- Random forest:

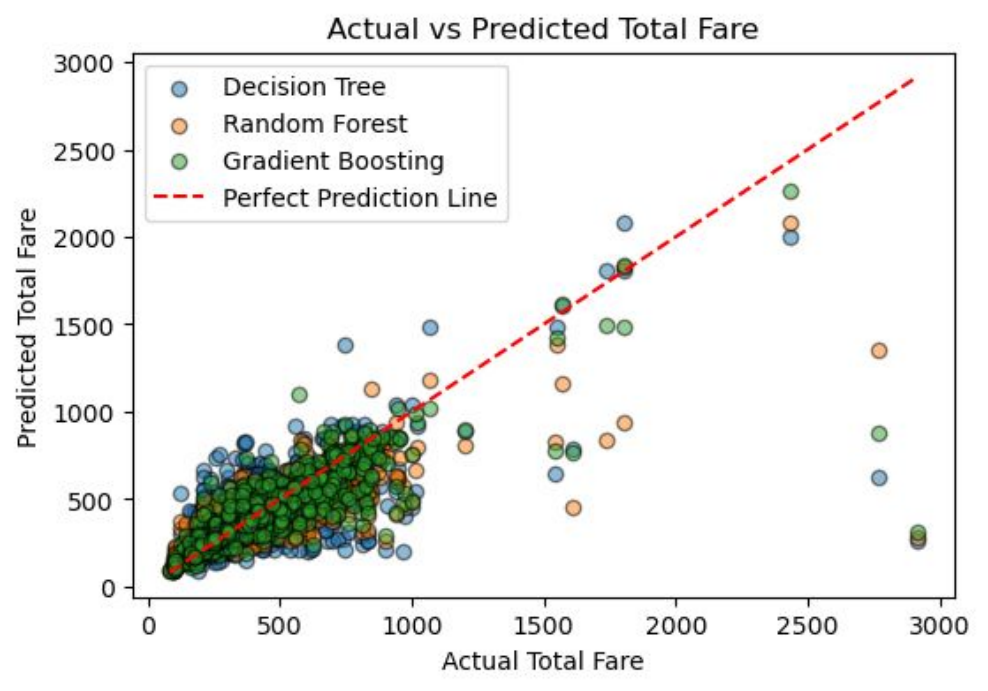
```
RMSE: 127.68198368653677
R² score: 0.6550369348689498
Accuracy: 61.228406909788866 %
```

- Gradient boosting:

```
RMSE: 119.30057359567645
R² score: 0.6988392160832606
Accuracy: 69.80166346769033 %
```

- Conclusion:
- Performance rank:
  1. Gradient boosting
  2. Random forest
  3. Decision tree
- R^2 score v.s. Accuracy
  1. The outcome of last two is similar in R^2 score,but different in accuracy.
  2. It may be caused by the number of tree.

Result & analysis



- Conclusion:
- Distribution:
  1. Gradient boosting is more scattered than others
  2. Random forest and Gradient boosting are slightly different, but better than the decision tree.

Result & analysis

```
Selected row:
     startingAirport destinationAirport  isBasicEconomy  isNonStop  \
3342             EWR                SFO           False      False

     AirlineCode transferAirport  departureTime  arrivalTime  totalFlightTime  \
3342  UA||DL||DL        DCA||MSP     1650222000   1650263340            29760

      elapsedDays  totalTravelDistance fareBasisCode  baseFare  totalFare
3342            0                 2725      HAA0AFEN    536.74      605.1

Predicted totalFare:
Decision Tree: 514.09
Random Forest: 648.3927333333336
Gradient Boosting 550.4990379737137
```

- Conclusion:

  By observing, it is unusual that the random forest performs better.
  The reason may be setting of hyper parameters, learning rate and subsamples.

08

Github link

“Our Github link.” — Click it, thanks!

09

Reference

Reference

Related paper

- RWA: A Regression-based Scheme for Flight Price Prediction

Dataset

- Flight Prices (kaggle.com)

Related knowledge

- RMSE
- R2_SCORE

10

Contribution of each member

Contribution of each member

111550114 趙堉安	Preprocessing data, Programming, topic conceiving.
111550060 劉千慈	Preprocessing data, making slides, topic conceiving.
111550074 陳映竹	Preprocessing data, Presentation, topic conceiving.

Thanks for listening!