Flight passenger satisfaction analysis and prediction

Master in Data Science
Final Project

Neural Academy

Ekaterina Suprunenko

15.07.2023

What: This dataset describes customer satisfaction based on pre-flight, in-flight and post-flight services and related events.

To do: The aim is to build a Machine Learning model to predict either the customer is satisfied with the service or not.

Storytelling:

We are living in the age where we make purchases, book services and use tools gladly relying on the other customer reviews.
The satisfaction of customers directly affects company's reputation and profitability. Bad customer experience costs dozens times more to a company than that of a happy customer.
Therefore, it is vital for businesses to keep up to the standards, constantly monitor the customer satisfaction, and gain a comprehensive understanding to work on the improvements.
Timely discover weak points of service may help from losing clients and a decrease of reputation.

Customer satisfaction is what lies between the company and its competitor.

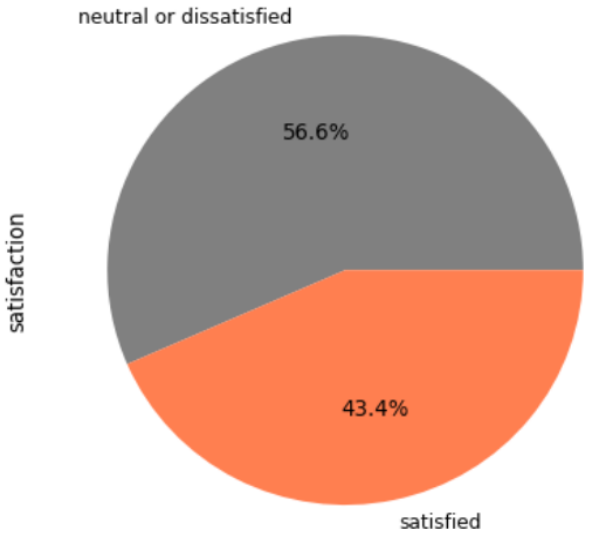
	Unnamed: 0	id	Gender	Customer Type	Age	Type of Travel	Class	Flight Distance	Inflight wifi service	Departure/Arrival time convenient	...	Inflight entertainme	On-board service	Leg room service	Baggage handling	Checkin service	Inflight service	Cleanliness	Departure Delay in Minutes	Arrival Delay in Minutes	satisfaction
0	0	70172	Male	Loyal Customer	13	Personal Travel	Eco Plus	460	3	4	...	5	4	3	4	4	5	5	25	18.0	neutral or dissatisfied
1	1	5047	Male	disloyal Customer	25	Business travel	Business	235	3	2	...	1	1	5	3	1	4	1	1	6.0	neutral or dissatisfied
2	2	110028	Female	Loyal Customer	26	Business travel	Business	1142	2	2	...	5	4	3	4	4	4	5	0	0.0	satisfied
3	3	24026	Female	Loyal Customer	25	Business travel	Business	562	2	5	...	2	2	5	3	1	4	2	11	9.0	neutral or dissatisfied
4	4	119299	Male	Loyal Customer	61	Business travel	Business	214	3	3	...	3	3	4	4	3	3	3	0	0.0	satisfied

We are given two datasets: train and test.
Both datasets have 25 columns, describing passengers and their evaluation of the offered services, as well as target column "satisfaction".

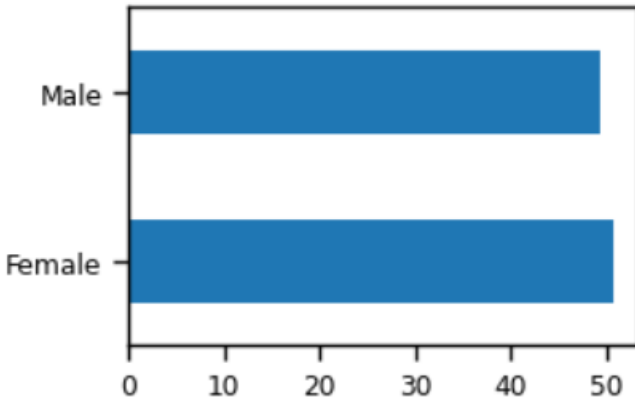
Train set consist of 103.904 rows, test set consists of 25.976 rows.

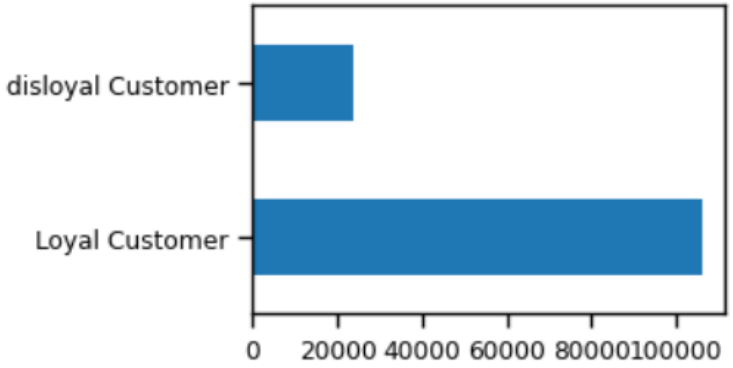
To facilitate data preprocessing and then final model fitting, I unite two datasets in one.

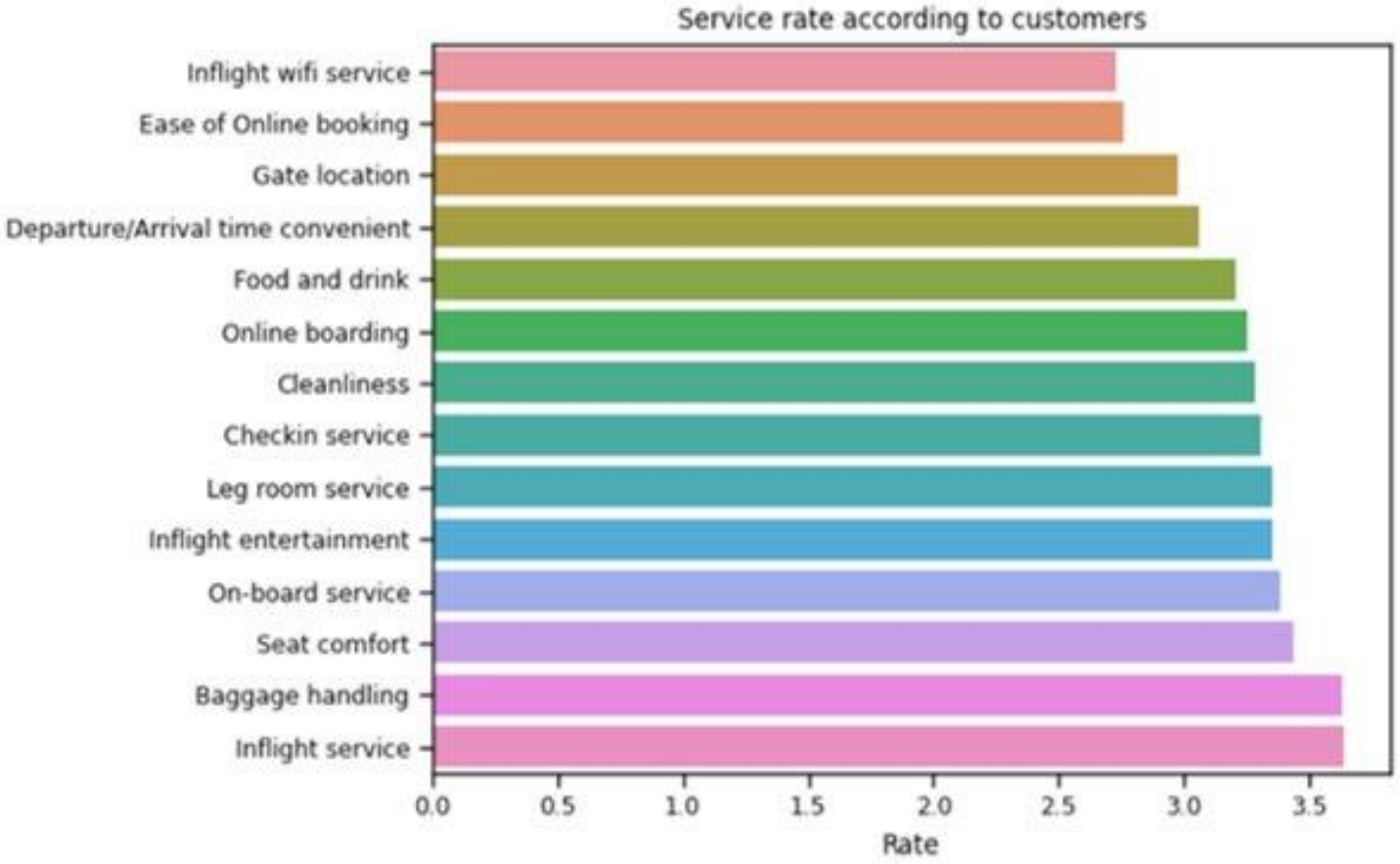
Exploratory Data Analysis

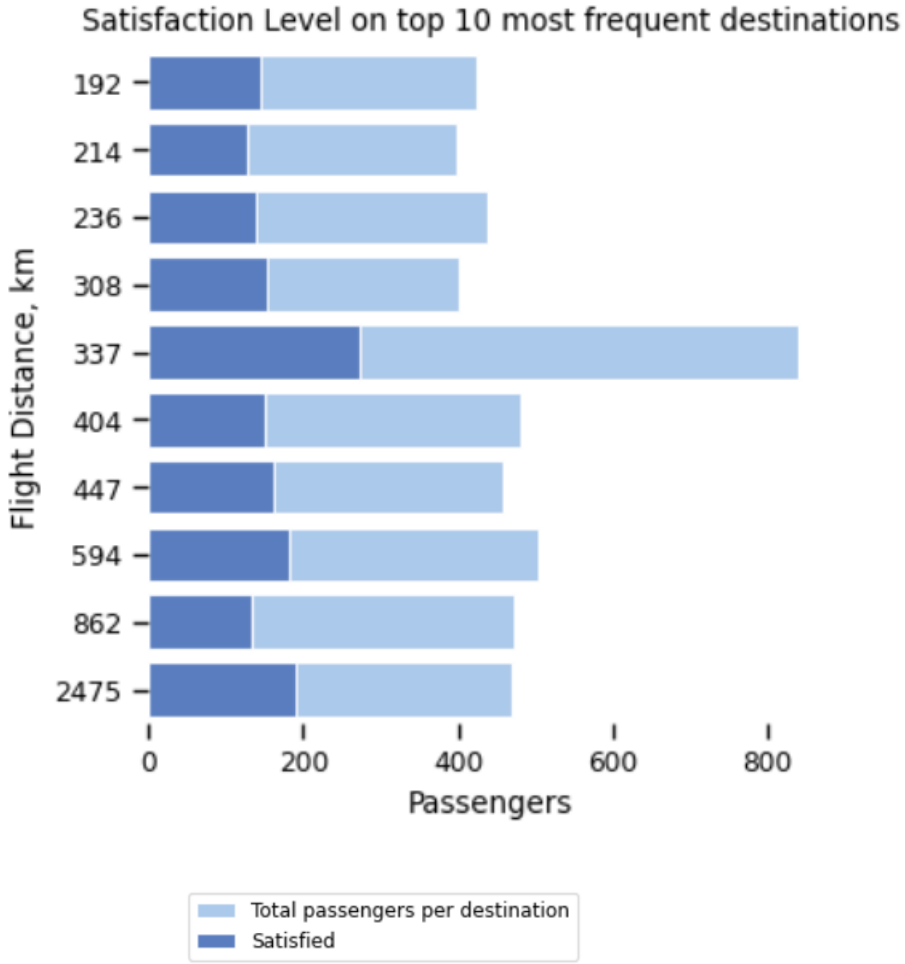


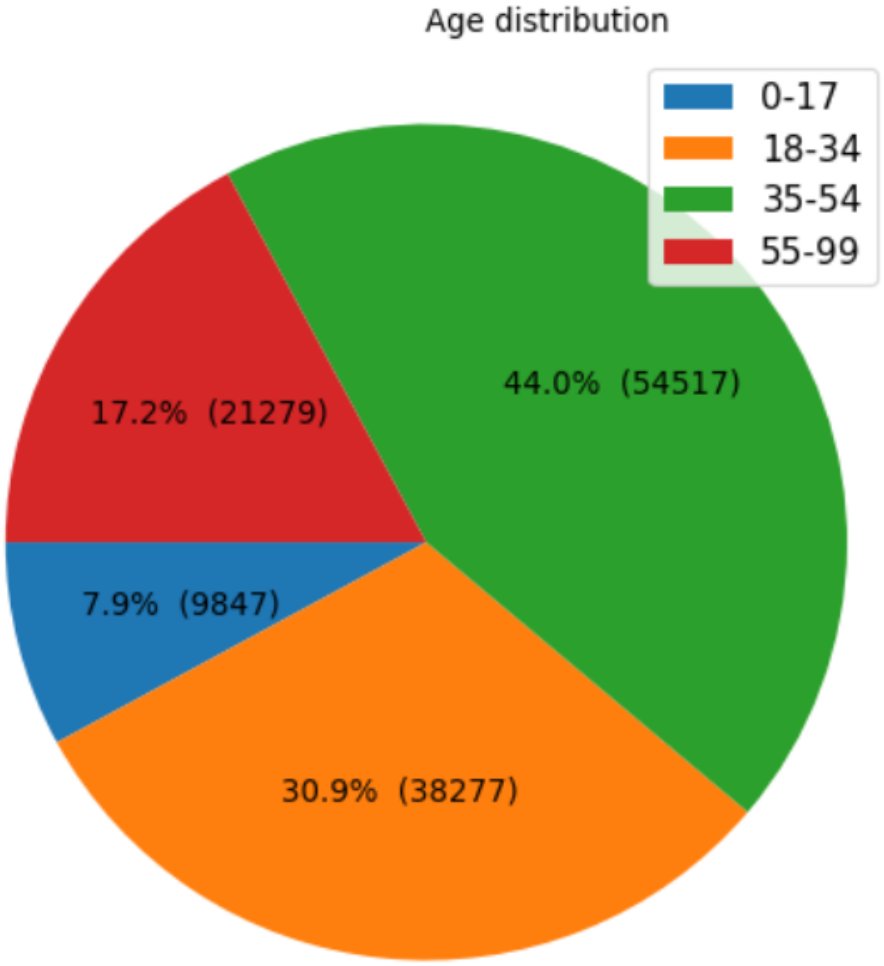
Ouch! More than a half of the customers are unhappy with the service.

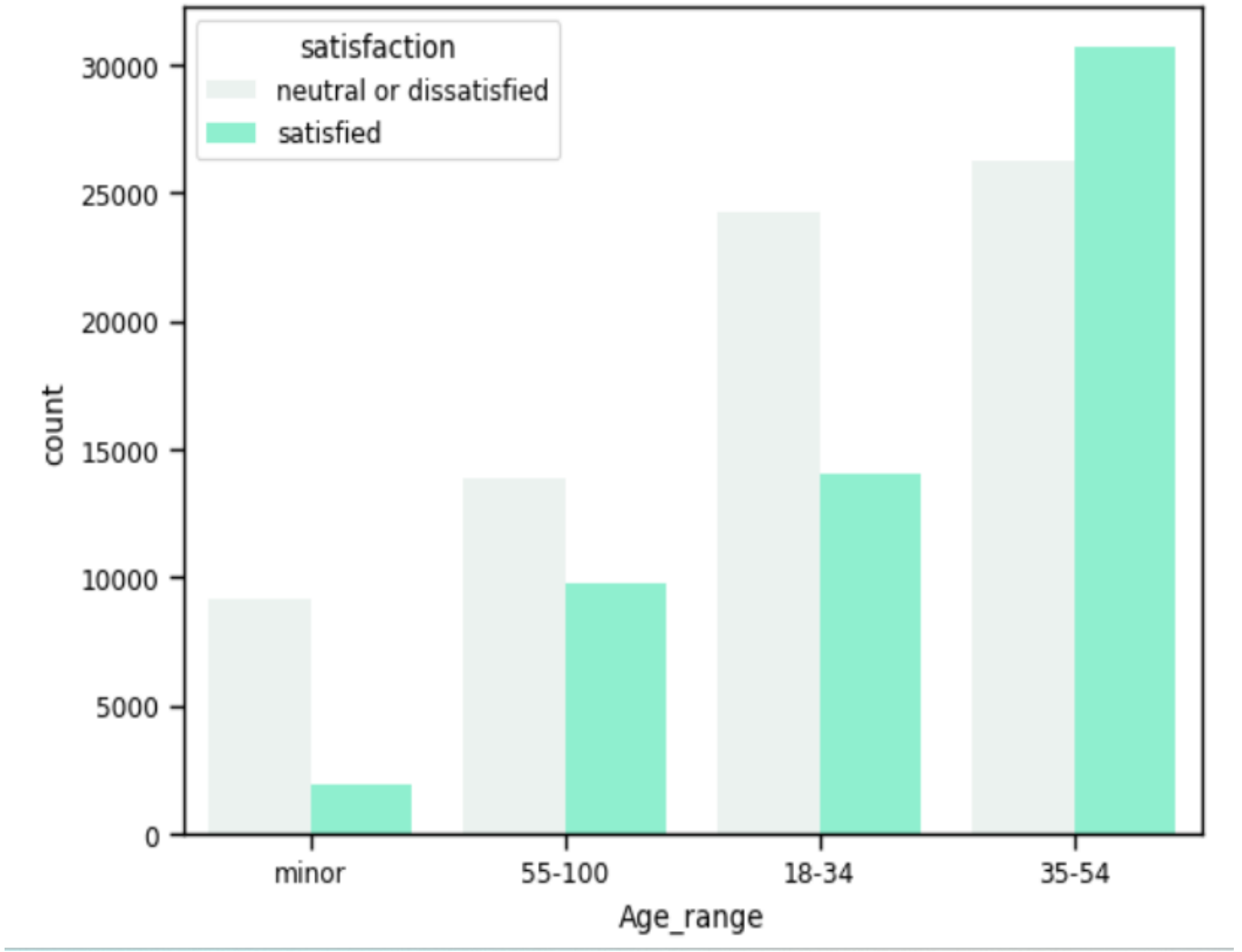





Service rate according to customers
Inflight wifi service
Ease of Online booking
Gate location
Departure/Arrival time convenient
Food and drink
Online boarding
Cleanliness
Checkin service
Leg room service
Inflight entertainment
On-board service
Seat comfort
Baggage handling
Inflight service
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Rate


Satisfaction Level on top 10 most frequent destinations
Flight Distance, km
192
214
236
308
337
404
447
594
862
2475
0
200
400
600
800
Passengers
Total passengers per destination
Satisfied


Age distribution
0-17
18-34
35-54
55-99
44.0% (54517)
17.2% (21279)
7.9% (9847)
30.9% (38277)


satisfaction
neutral or dissatisfied
satisfied
30000
25000
20000
15000
10000
5000
0
count
minor
55-100
18-34
35-54
Age_range

Machine Learning Models:

1. DecisionTreeClassifier

`Accuracy Score DecisionTreeClassifier: 0.9242`

2. K-Nearest Neighbor

`Accuracy Score KNN Classifier: 0.7385`

3. RandomForestClassifier

`Accuracy Score RandomForest: 0.9496`

4. XGBoost

`Accuracy Score XGBoost: 0.9506`

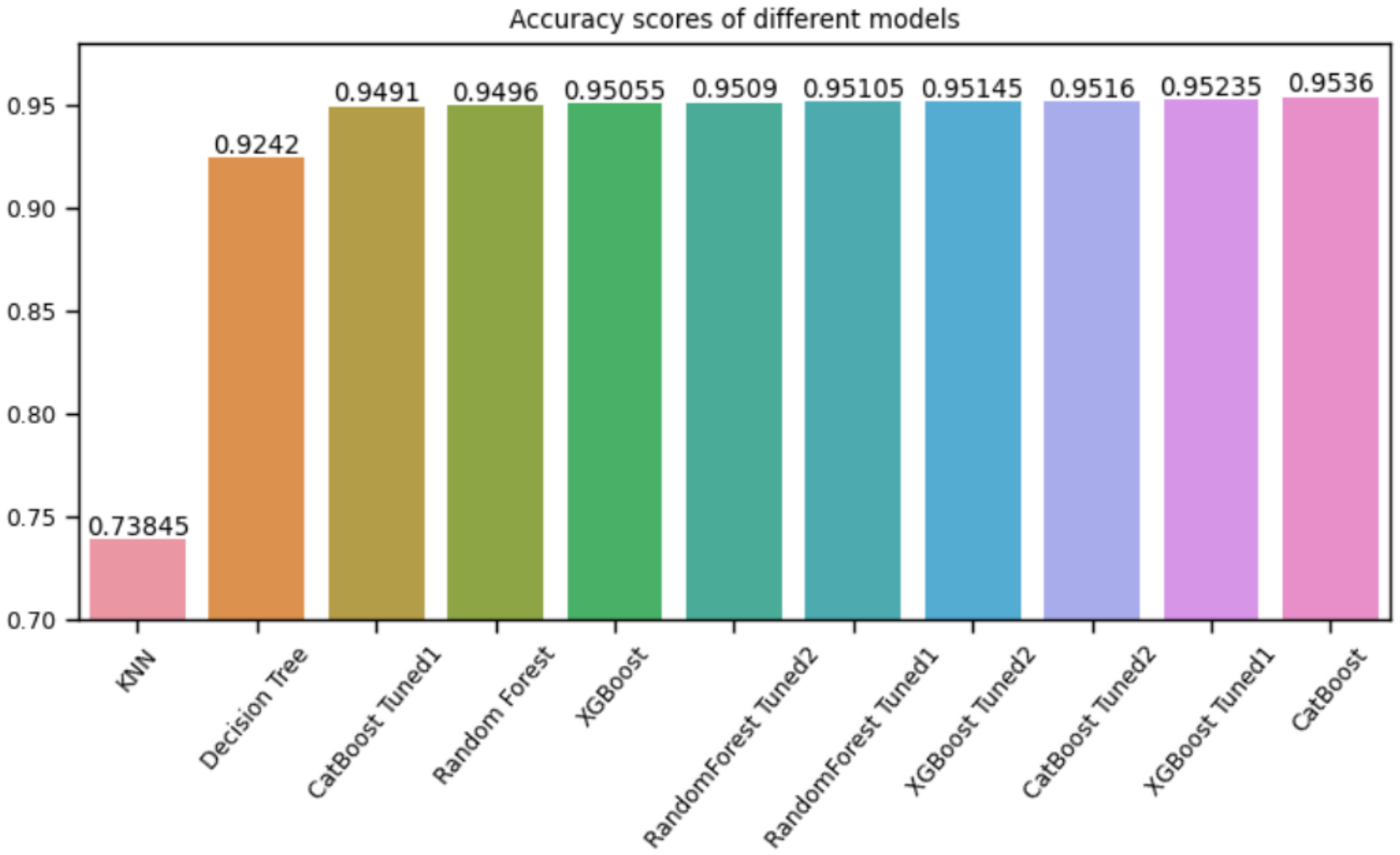
5. CatBoost

`Accuracy Score CatBoost: 0.9536`

Hyperparameters Tuning on selected models

MODEL	NON-TUNED	1ST ATTEMPT Random Search	2ND ATTEMPT Random Search
1. RandomForest	0.9496	0.9510 ↑	0.9509
2. XGBoost	0.9506	0.9524 ↑	0.9515
3. CatBoost	0.9536 ↑	0.9491	0.9516

Model selection after hyperparameters tuning



Model Ensemble

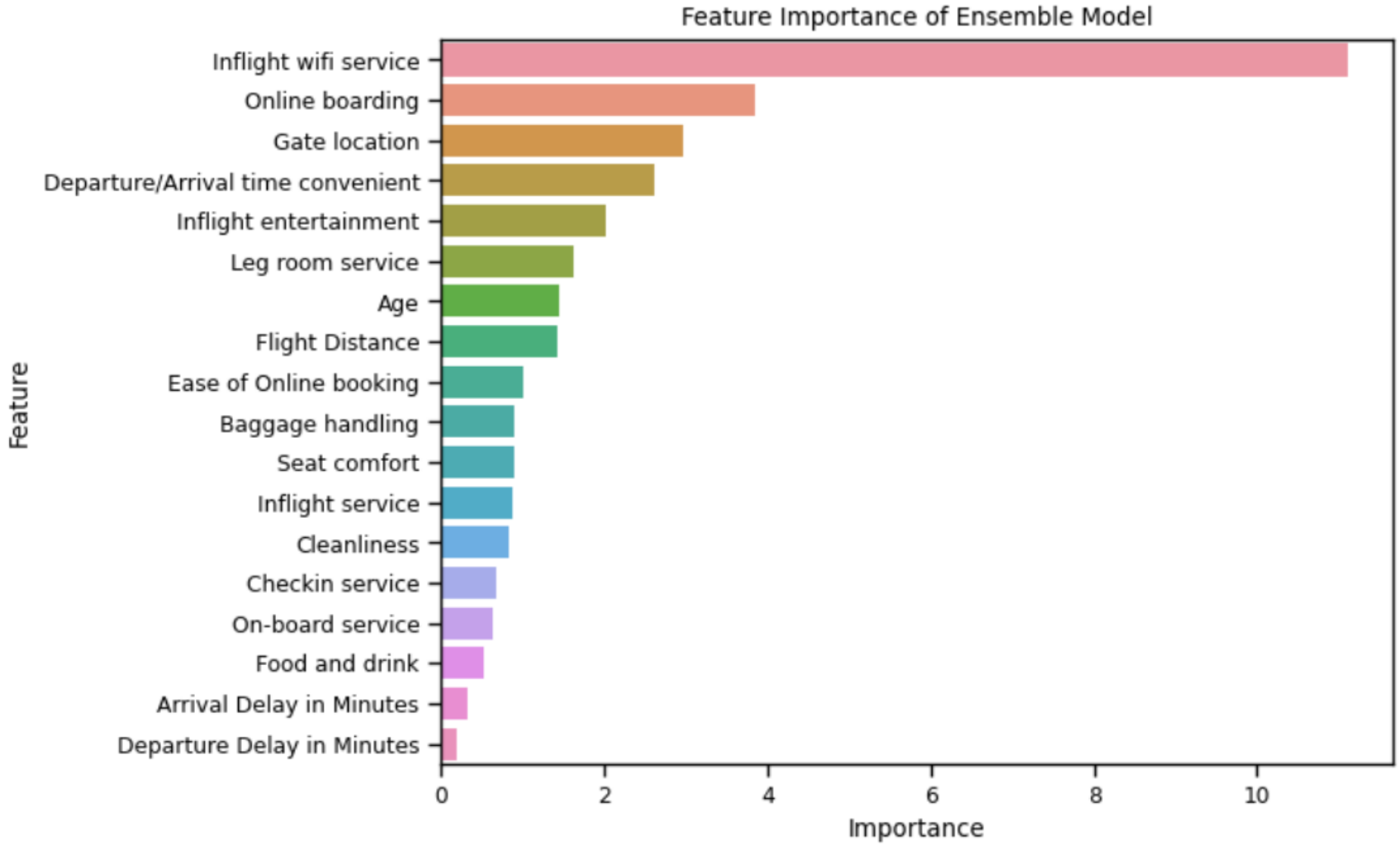
Voting Classifier (Soft Voting): Random Forest Tuned1 + XGBoost Tuned1+ CatBoost

Classification report: Final Ensemble Method

	precision	recall	f1-score	support
0	0.95	0.97	0.96	11257
1	0.96	0.94	0.95	8743
accuracy			0.95	20000
macro avg	0.95	0.95	0.95	20000
weighted avg	0.95	0.95	0.95	20000

Accuracy Score ENSEMBLE: 0.9536

Feature Importance



Insights & conclusions

Resume:

Comes out, the things that make passengers happier are (quite predictable):

1. **wi-fi during the flight** (no annoyed children or teens, adults can keep doing business)
2. **online boarding pass** - less queues - happier the passenger!
3. **gate location** - again, less efforts - happier the passenger

Unexpectedly come in the tail delays and food service. Baggage handling, that at the beginning seemed to be a promising feature, does not actually change the story: it's average rating is only 1,5 out of 10.

Final model testing on unseen data

	precision	recall	f1-score	support
0	0.95	0.97	0.96	11361
1	0.96	0.93	0.94	8639
accuracy			0.95	20000
macro avg	0.95	0.95	0.95	20000
weighted avg	0.95	0.95	0.95	20000

Accuracy Score TEST: 0.9508