

Data Analysis Project I

Aegean Airlines Passenger Satisfaction



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1) ABSTRACT

The expectation of customers from an airline is increasing as new technologies are introduced. The customers not only expect safe transportation but also expects more benefits and facilities through their journey. Therefore, the airline industries are working more on satisfying the customers by giving the facilities and comfort which customer expects. As customers, satisfaction with the services provided by the airline is very crucial for the market share loss of an airline. The Aegean Airlines, which is one of the leading airlines has conducted a survey to identify the customer satisfaction towards their services provided. A prediction model is to be expected to build to predict the customers' satisfaction from the given factors. The important factors that influence the satisfaction of the customer to be identified, so that the airlines can come up with a good marketing strategy and service quality improvement strategy.

In this report, descriptive analysis has been done on the data collected from 130K customers using python. It has been found out that the services provided for the economy class and economy class are not good as the services provided to the business class. The middle-aged customers are more satisfied than the youngsters since they are providing a good cleanliness environment and seat comfort but poor WI-FI services. Youngsters are not satisfied with the food and drinks provided by the airlines. Long-distance travelers are more satisfied than short-distance travelers. The airlines providing good on-board services and check-in services but still, there is room to develop it to attract disloyal customers.

It has been decided to use logistic regression, Naïve Bayes, Decision Tree, Random forest, and XG boost algorithms to create a prediction model that predicts whether a customer is satisfied or not with the airlines' services. A website for the airline will be created with the functionality that includes the prediction model.

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5) INTRODUCTION

In earlier days, airline companies were only interested in the transportation of people and their safety. But in recent times they consider giving a pleasant experience to customers from buying a ticket for their journey till they reach their destination is just as important. Satisfaction is not only considered as a customer's goal to be derived as a result of degrading services but also as a company's goal, as a way of getting higher customer retention rates and ways of generating profits (Surapranata & Iskandar, 2013). If the service is provided in accordance with customer expectations, he will feel satisfied that increase the level of consumer loyalty. Conversely, if service delivery is lower than customer expectation, service quality will be considered bad and will decrease customer loyalty (Saribanon et al., 2016), (Simarmata & Keke, 2017).

Measuring customer satisfaction is a key element for modern businesses as it can significantly contribute to a continuing effort of service quality improvement (Tsafarakis, Kokotas, and Pantouvakis, 2018). Understanding the quality of service is centered on the fulfillment of customer wants and needs and on delivering them to meet customer expectations in a service (Service & Services, 2011). Hence, almost every airline company measures the satisfaction of the customers regularly to know whether the service they offer is up to the standard of the customers.

6) DESCRIPTION OF THE PROBLEM

Passenger dissatisfaction and satisfaction in the services and other factors of the airline industry are very crucial for the market share loss of an airline. Therefore, Aegean Airlines needed to know how they can increase the number of passengers by providing more satisfaction towards their services.

This study aims to examine the most important factors that influence the passenger's expectation from an airline service from the given dataset. This can help the Aegean airlines to create marketing strategies and quality improvement mechanism plans effectively to cope up with the other massive airlines. Finally, creating a website for Aegean airlines with the main feature that will predict whether a customer is satisfied or not through the important factors that influence the satisfaction of customer that have been found out from the study.

7) DESCRIPTION OF THE DATASET

The dataset is contained airline passenger satisfaction survey data. It consists of 130000 customer feedbacks containing 24 features including both qualitative and quantitative.

Satisfaction is the response variable in this study.

No.	Variable name	Description	Type of the variable
1.	satisfaction	Airline satisfaction level (Satisfaction, neutral, or dissatisfaction)	qualitative
2.	id	Customer identification number	
3.	gender	Gender of the passengers (Female, Male)	qualitative
4.	age	The actual age of the passengers	quantitative

5.	type_of_travel	Purpose of the flight of the passengers (Personal Travel, Business Travel)	qualitative
6.	customer_class	Travel class in the plane of the passengers (Business, Eco, Eco Plus)	qualitative
7.	customer_Type	The customer type (Loyal customer, disloyal customer)	qualitative
8.	flight_distance	The flight distance of this journey	quantitative
9.	inflight_wifi_service	Satisfaction level of the inflight wifi service (0:Not Applicable;1-5)	qualitative
10.	ease_of_online_booking	Satisfaction level of online booking	qualitative
11.	inflight_service	Satisfaction level of inflight service	qualitative
12.	online_boarding	Satisfaction level of online boarding	qualitative
13.	inflight_entertainment	Satisfaction level of inflight entertainment	qualitative
14.	food_and_drink	Satisfaction level of Food and drink	qualitative
15.	seat_comfort	Satisfaction level of Seat comfort	qualitative
16.	leg_room_service	Satisfaction level of Leg room service	qualitative
17.	baggage_handling	Satisfaction level of baggage handling	qualitative
18.	gate_location	Satisfaction level of Gate location	qualitative
19.	cleanliness	Satisfaction level of Cleanliness	qualitative
20.	check_in_service	Satisfaction level of Check-in service	qualitative
21.	departure_delay_in_minutes	Minutes delayed when departure	quantitative
22.	arrival_delay_in_minutes	Minutes delayed when Arrival	quantitative
23.	onboard_service	Satisfaction level of onboard service	qualitative
24.	departure_arrival_time_convenient	Satisfaction level of departure and arrival time convenient	qualitative

Table 7-1: Description of the Dataset

8) DESCRIPTIVE ANALYSIS

1) Analysis of Customer Class

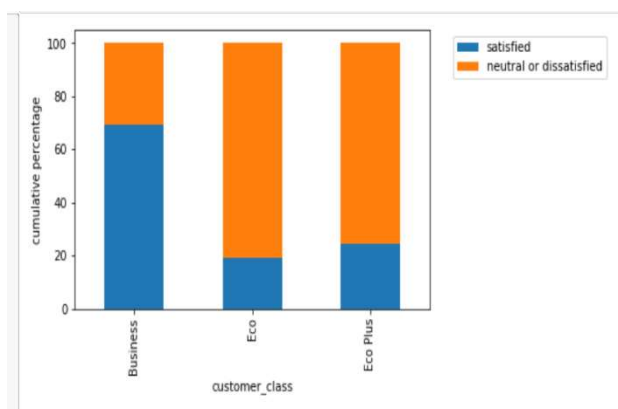


Figure 8 - 1: Stacked Bar Graph of Customer Class vs Satisfaction

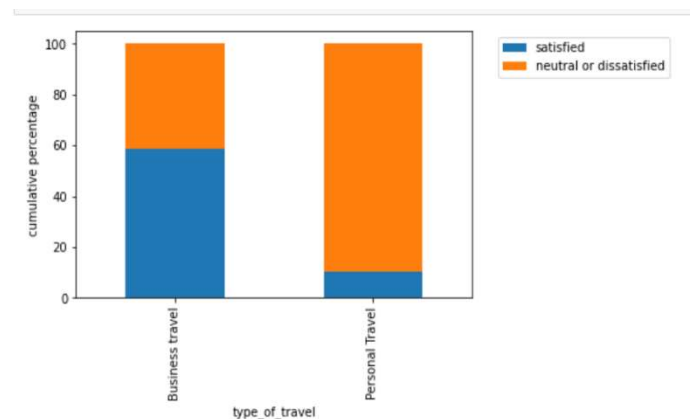


Figure 8 - 2: Stacked Bar Graph of Type of Travel vs Satisfaction

According to USA today and Covington travel business class have upgraded services than the economy class and they are most probably satisfied with the airline services. This is proved in our study too. We

can see that the people who travel in business class are more satisfied with the services than the people who travel in

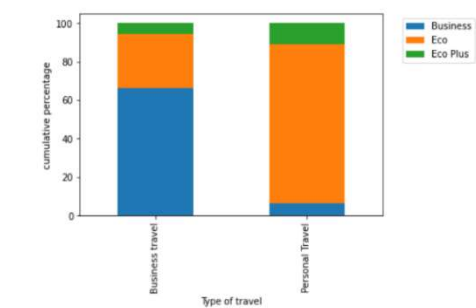


Figure 8 - 3: Stacked Bar Graph of Type of Travel

economy and economy plus classes from the figure. We can see that the people travel for personal reason are more dissatisfied with the airlines from the figure. The reason for that is the people who travel personal purpose mostly travel in Economy or Economy plus class and people travel for business purposes travel in business class. Therefore, it can be concluded that the business class services better than the other two. It is important to give good services in economy and economy plus to attract the customers travel for personal reasons and also the customers choose cheaper classes.

2) Analysis of Age

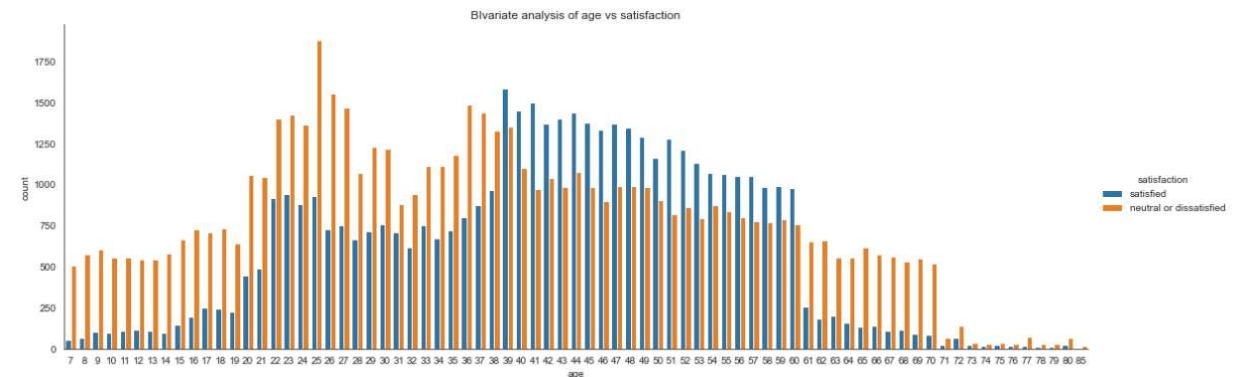


Figure 8 - 4: Histogram of Age

Here we can clearly see that the middle age people are more satisfied and youngsters are either dissatisfied or neutral with this airline.

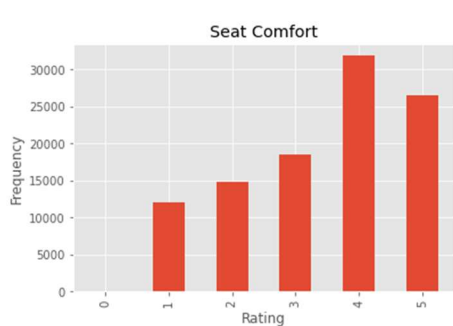


Figure 8 - 6: Bar Graph of Seat Comfort

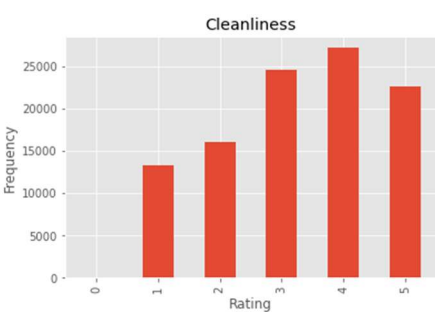


Figure 8 - 7: Bar Graph of Seat Comfort

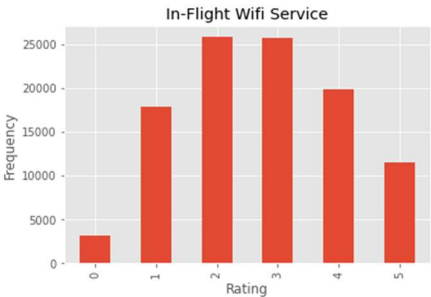


Figure 8 - 5: Bar Graph of Seat Comfort

Middle-age people want highly comfortable seats (Hiemstra-van Mastrigt, 2015). According to a Business traveler article, people prefer more cleanliness in Airplane. Since both seat comfort level and cleanliness level are higher, we can assume that middle-aged people have a higher satisfaction level. Youngsters expect a good WI-FI service (Mason, 2017). The WI-FI service is poor according to the figure of In-Flight WI-FI service. According to Immarsat WI-FI solutions, airlines expected to have good WI-FI services. It can be the reason for the higher number of unsatisfied young passengers.

3) Analysis of Food and Drink

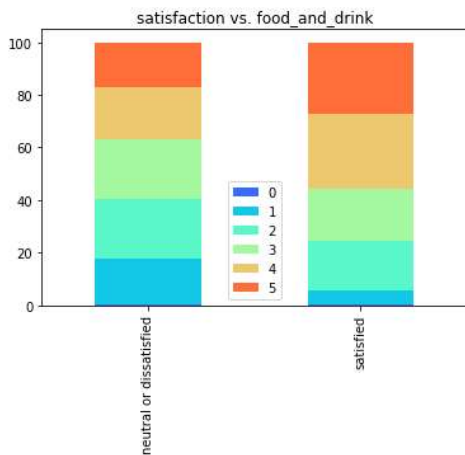


Figure 8 - 9: Stacked Bar Graph of Satisfaction vs Food and Drink

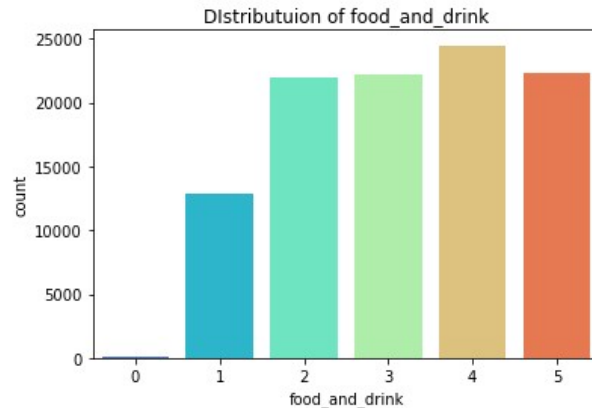


Figure 8 - 8: Bar Graph of Food and Drink

In-flight food and drink, which are prepared in the way that airline passengers enjoy, can influence an individual's perception of its satisfaction. According to the previous studies (Han and Hwang, 2017; Koklic et al., 2017), implies that airline passengers' satisfaction is an important variable to explaining their decision-making process. In this regard, we should focus on improving the overall perception of in-flight food and drinks quality.

By looking at satisfaction levels of food and drink we can see that most of the customers selected 3 to 5 levels. It means available food and drinks are much satisfied. When considering the satisfaction vs. food and drink graph you can see that most of 4, 5 level selected customers are satisfied with the airline, and most of 0 level selected customers are neutral or dissatisfied with the airline. So, we can further improve in-flight food and drink. Satisfaction with food and drink is varying with the age.

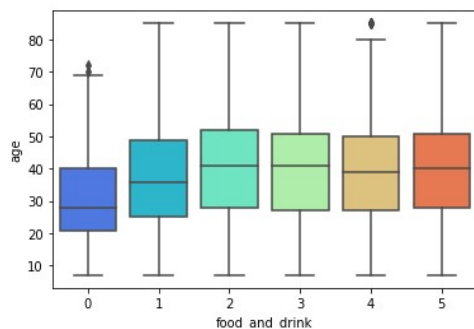


Figure 8 - 10: Boxplots of Age vs Food and Drink

By looking at the age vs. food and drink graph, here we mainly focus on customers in level 0 who are dissatisfied with available food and drinks. You can clearly see that most of the customers below 40 were selected level 0 as their satisfaction level. So, they should take the opportunity to create more hygienic and delicious food and drink for their customers.

As noted by Heide et al, providing good in-flight food and services has generated positive word-of-mouth communication among the passengers. Passengers who are pleased with the quality of in-flight food and drink served by the airlines will recommend the airlines to others. Positive word of mouth is an important source of information in the selection of airlines.

4) Analysis of Onboard Service

By looking at the onboard service vs. satisfaction graph, we can see that most of the customers who selected onboard service satisfaction levels 4 and 5 are satisfied with the airline. Also, most of the customers who selected onboard service satisfaction levels 1,2, and 3 are neutral or dissatisfied with the airline. Thus, it is important to consider onboard service satisfaction to improve airline passenger

satisfaction. From the above, we have discussed about food and drinks and now we have to consider other variables which belong to onboard service.

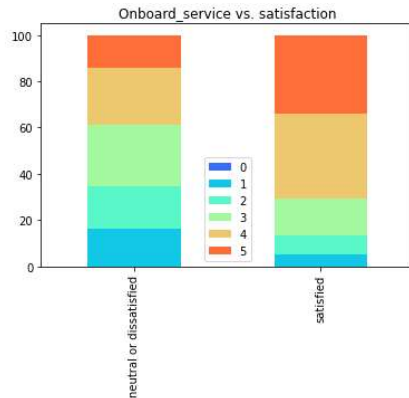


Figure 8 - 12: Stacked Bar Graph of Satisfaction vs Onboard Service

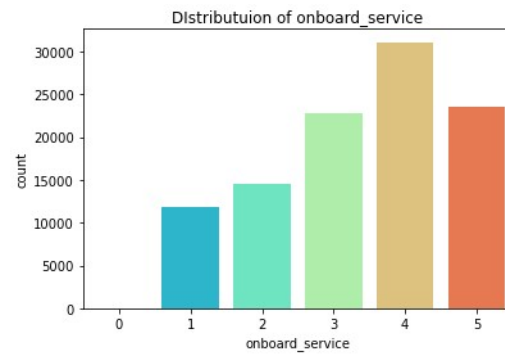


Figure 8 - 11: Bar Graph of Onboard Service

5) Analysis of Seat Comfort

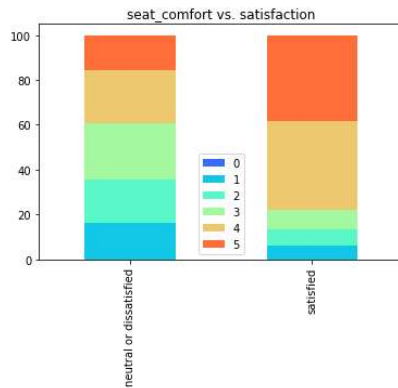


Figure 8 - 13: Stacked Bar Graph of Satisfaction vs Seat Comfort

It means available seat comfort is much satisfied. Most customers who have selected seat comfort satisfaction levels as 4 and 5 are satisfied with the airline. Also, most customers who have selected seat comfort satisfaction levels as 1, 2, and 3 are neutral or dissatisfied with the airline. So, we can further improve seat comfort to get good satisfaction from customers.

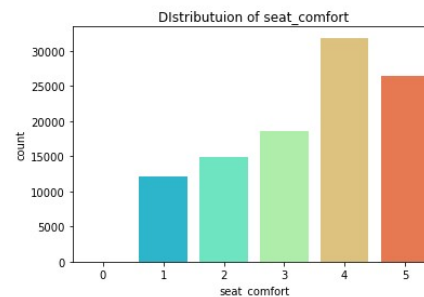


Figure 8 - 14: Bar Graph of Seat Comfort

6) Analysis of Flight Distance

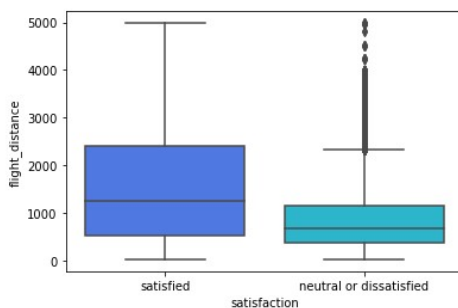


Figure 8 - 15: Boxplots of Satisfaction vs Flight Distance

Here we can see that most of the customers who traveled long flight distance are satisfied with our airline. The reason for that is people look for good onboard service and seat comfort when they are traveling long distances. From the above, we discussed about customer satisfaction on onboard service and seat comfort. Since most of the customers satisfied with those two, they tend to satisfy with our airline.

7) Analysis of Customer Type

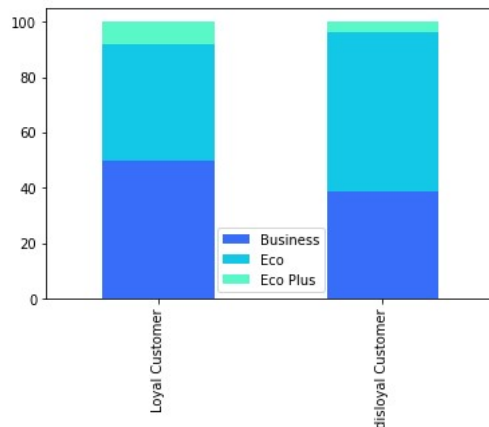


Figure 8 - 16: Stacked Bar Graph of Customer Type vs. Customer Class

Customer loyalty is rooted in economic benefits to the customer, which drives repeat purchases. According to the influence of airline service quality on passenger satisfaction and loyalty by Juliet Namukasa, they conclude that passenger satisfaction had a significant effect on passenger loyalty. As earlier found out, the people who fly in economy class are more dissatisfied than the people who fly in business class. From the graph, it is clear that most disloyal customers travel in economy class. This can be a reason for the majority dissatisfaction among the disloyal customers. Thus, we have to give more concern to develop economy class facilities in order to maximize customer loyalty and satisfaction.

The airline frequent flyer program is a customer loyalty program in which the airline provides offers and benefits, such as free flights and products, based on the number of miles a customer has flown. Customers choose to fly on airlines where they have accumulated the most miles. At the same time, loyalty is not exclusive since customers can enroll in an unlimited amount of customer loyalty programs.

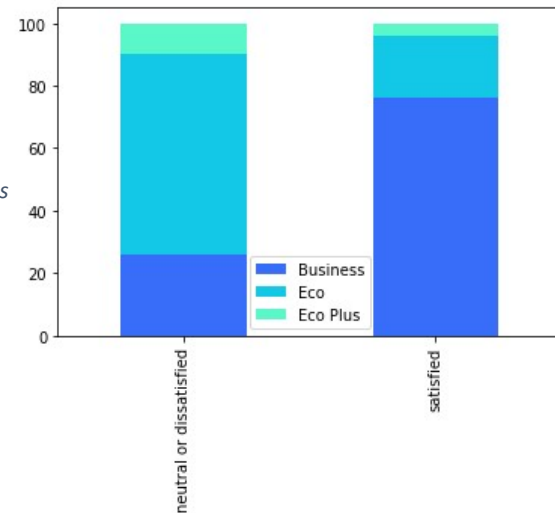


Figure 8 - 17: Stacked Bar Graph of Satisfaction vs Customer Class

8) Analysis of In-Flight Entertainment and Cleanliness

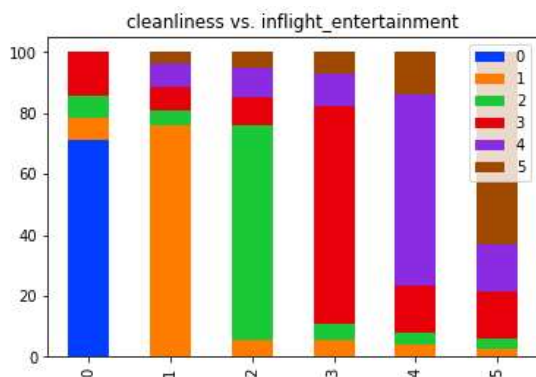


Figure 8 - 18: Stacked Bar Graph of Cleanliness vs In-Flight Entertainment

According to the figure, when the level of cleanliness increases, the level of in-flight entertainment also increases. Also, there exists a higher correlation between those two variables (0.66). Many people do not associate the IFE with cleanliness. But clearly, there is a relationship. The remote of the entertainment system has been touched by many passengers. It had to be cleaned on a regular basis. Also, the touch screen in the flight needed to be cleaned to get rid of the fingerprints. The passengers also need to have a cleaner headset. (Airline Cabin Cleanliness | SKYTRAX, 2021) Therefore, the airlines should provide a cleaner environment to the passengers so that passengers can have good entertainment onboard.

9) Analysis of Check-In Service

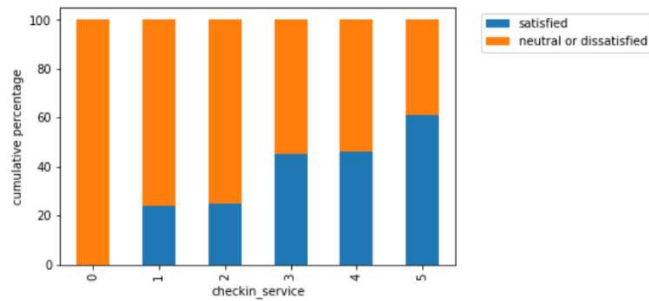


Figure 8 - 19: Stacked Bar Graph of Satisfaction vs Check-In Service

The percentage of satisfied customers increases when the level of check-in services improves, as in the figure. Usually, there are long waiting lines at check-in counters and it takes a lot of time. But, if self and mobile check-in were implemented well, it will give an impact on short waiting time and easiness for passengers (Putri, Harisha, and Widyastuti, 2018). With that, passenger satisfaction will increase.

10) Analysis of Legroom Service



Figure 8 - 20: Stacked Bar Graph of Customer Class vs Legroom Service

Airlines are often compared in terms of the amount of "legroom" they provide in each class of service (Legroom - Wiki - SmarterTravel.com, 2021). From the figure, it is clear that the passengers in business class have higher legroom than the economy and eco-plus classes in this airline. This can be another reason for the earlier mentioned higher percentage of satisfied customers of the business class.

11) Correlation Plots

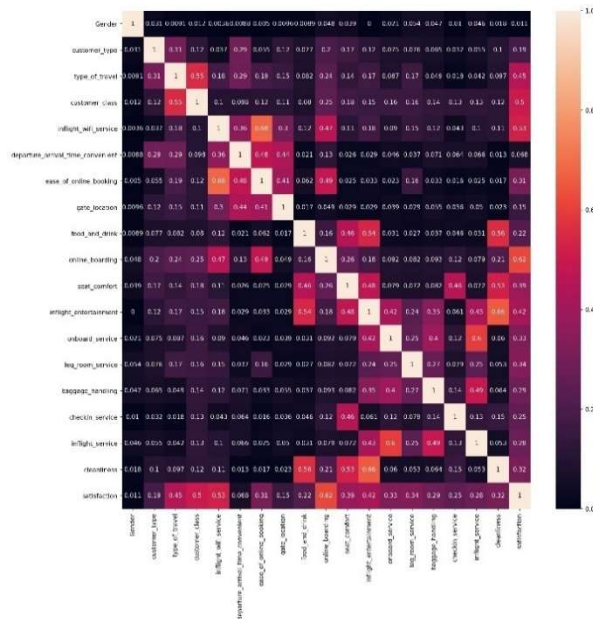


Figure 8 - 22: Correlation Plot of Numerical Variables

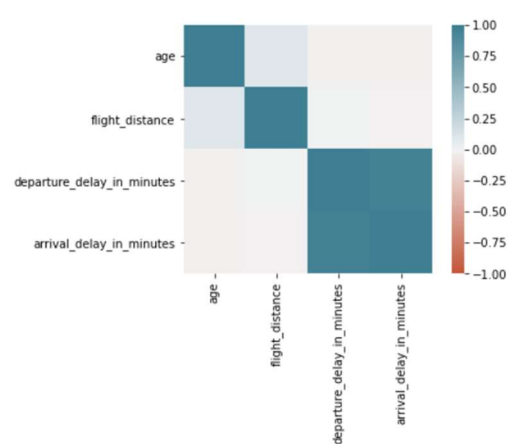


Figure 8 - 21: Correlation Plot of Numerical Variables

According to the correlation plot, we notice that there are some correlations between variables. They are ease of online booking and inflight Wi-Fi service. Online boarding and satisfaction, cleanliness and inflight entertainment, onboard service, and inflight service. Also, there is correlation between Arrival Delay in Minutes and Departure Delay in Minutes.

9) Suggestions

From the study, it can be said that Aegean Airlines should improve certain factors to get more attention and loyalty from the customers and to get a competitive advantage over other airline services. Aegean airlines should improve the services and facilities given to the economy class and economy plus class customers. They should consider giving good WI-FI services in the airplane and delicious food which attracts youngsters to improve the satisfaction level of young people. The airlines should consider improving the airplanes used for short distant travels. They also should consider the legroom facility and seat comfort facility provided in economy and economy plus class to increase the number of loyal customers.

Finally, our main goal is to create an attractive website for the Aegean airlines including the functionality which predicts whether a customer is satisfied or not by considering the important factors. Logistic regression, Naïve Bayes technique, Decision tree, Random Forest, and XG-boost techniques are planned to be used to create a model for the prediction since it is a classification problem.

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11) Appendix

```
In [10]: train.isnull().sum()
```

```
Out[10]: Gender                                0
customer_type                                0
age                                            0
type_of_travel                               0
customer_class                               0
flight_distance                              0
inflight_wifi_service                        0
departure_arrival_time_convenient           0
ease_of_online_booking                      0
gate_location                               0
food_and_drink                              0
online_boarding                             0
seat_comfort                                0
inflight_entertainment                       0
onboard_service                             0
leg_room_service                            0
baggage_handling                            0
checkin_service                             0
inflight_service                             0
cleanliness                                 0
departure_delay_in_minutes                   0
arrival_delay_in_minutes                     318
satisfaction                                 0
dtype: int64
```

```
In [11]: train['arrival_delay_in_minutes'].fillna(0, inplace = True)
```

```
In [18]: #customer_class Vs. satisfaction
```

```
cat1 = train['customer_class'] == 'Business'
cat2 = train['customer_class'] == 'Eco'
cat3 = train['customer_class'] == 'Eco Plus'

sat = train['satisfaction']
catscore1 = sat[cat1]
catscore2 = sat[cat2]
catscore3 = sat[cat3]
freq1 = catscore1.value_counts()
freq2 = catscore2.value_counts()
freq3 = catscore3.value_counts()

plotdata = pd.DataFrame({'Business': freq1, 'Eco': freq2, 'Eco Plus': freq3})
plotdata.plot(kind='bar', stacked = True)

plotdata1 = plotdata.div(plotdata.sum(axis=1), axis = 0) * 100
plotdata1.plot(kind='bar', stacked = True)
plt.title('customer_class vs. satisfaction')
```

```
In [76]: sns.boxplot(x='food_and_drink', y = 'age', data=train)
fig = plt.figure(figsize=(15,15))
fig.savefig('flightdistance.jpg', bbox_inches='tight', dpi=150)
plt.show()
```

```
In [205]: train['seat_comfort'].value_counts().sort_index().plot.bar()
plt.xlabel('Rating')
plt.ylabel('Frequency')
plt.title('Seat Comfort')
```

```
In [30]: corr = train[numerical_features].corr()
ax = sns.heatmap(
    corr,
    vmin=-1, vmax=1, center=0,
    cmap=sns.diverging_palette(20, 220, n=200),
    square=True
)
fig = plt.figure(figsize=(15,15))
fig.savefig('numericalcorr.jpg', bbox_inches='tight', dpi=150)
plt.show()
```

```
In [38]: def cramers_v(x, y):
    x = np.array(x)
    y = np.array(y)
    confusion_matrix = pd.crosstab(x, y)
    chi2 = stats.chi2_contingency(confusion_matrix)[0]
    n = confusion_matrix.sum().sum()
    phi2 = chi2/n
    r,k = confusion_matrix.shape
    phi2corr = max(0, phi2-((k-1)*(r-1))/(n-1))
    rcorr = r-((r-1)**2)/(n-1)
    kcorr = k-((k-1)**2)/(n-1)
    return np.sqrt(phi2corr/min((kcorr-1),(rcorr-1)))

cramersv = pd.DataFrame(index=train_cat.columns, columns=train_cat.columns)
columns = train_cat.columns

for i in range(0, len(columns)):
    for j in range(0, len(columns)):
        #print(data[columns[i]].tolist())
        u = cramers_v(data[columns[i]].tolist(), data[columns[j]].tolist())
        cramersv.loc[columns[i], columns[j]] = u

cramersv.fillna(value=np.nan, inplace=True)
```

```
In [39]: fig = plt.figure(figsize=(15,15))
sns.heatmap(cramersv, annot=True)
fig.savefig('catcorr.jpg', bbox_inches='tight', dpi=150)
plt.show()
```

```
In [35]: with sns.axes_style('white'):
    g = sns.catplot(x='age', data=train, aspect=3.0, kind='count', hue='satisfaction')
    plt.title('Bivariate analysis of age vs satisfaction')
    fig = plt.figure(figsize=(15,15))
    fig.savefig('agevssatisfaction.jpg', bbox_inches='tight', dpi=150)
    plt.show()
```

```
In [21]: #seat_comfort vs. satisfaction
```

```
cat1 = train['seat_comfort'] == 1
cat2 = train['seat_comfort'] == 2
cat3 = train['seat_comfort'] == 3
cat4 = train['seat_comfort'] == 4
cat5 = train['seat_comfort'] == 5
cat0 = train['seat_comfort'] == 0

sat = train['satisfaction']
catscore1 = sat[cat1]
catscore2 = sat[cat2]
catscore3 = sat[cat3]
catscore4 = sat[cat4]
catscore5 = sat[cat5]
catscore0 = sat[cat0]
freq1 = catscore1.value_counts()
freq2 = catscore2.value_counts()
freq3 = catscore3.value_counts()
freq4 = catscore4.value_counts()
freq5 = catscore5.value_counts()
freq0 = catscore0.value_counts()

plotdata = pd.DataFrame({'0': freq0, '1': freq1, '2': freq2, '3': freq3, '4': freq4, '5': freq5})
plotdata.head()

plotdata1 = plotdata.div(plotdata.sum(axis=1), axis = 0) * 100
plotdata1.plot(kind='bar', stacked = True)
plt.title('seat_comfort vs. satisfaction')
```