1.INTRODUCTION:

1.1OVERVIEW

This Global Air Transportation Network dataset is a comprehensive collection of information on airports, airlines and their routes. It contains information such as names, cities, countries, codes (IATA and ICAO) longitudes, latitudes and altitudes of airports across the world with detailed time zone and daylight saving time data. Additionally, this includes information about airlines including their IDs, name aliases, IATA and ICAO codes, callsigns country of origin and active/inactive status. Similarly, it also covers route details such as airline sources to destination airports along with essential details like codeshare stakeholder if any stops required during this journey along with the type of aircraft being used for that particular journey. This dataset has been compiled through meticulous labor by researchers all over the world to give you a comprehensive detail into air transportation networks from around the globe. It requires your generous donations in order for them to keep updating this data source so please do donate if possible.

1.2 PURPOSE

Business requirements

The business requirement of the Global Air Transportation Network- Airports, Airlines, and Routes dataset is to provide stakeholders in the aviation industry with accurate, up-to-date information on the worldwide air transportation network. The dataset is intended to help stakeholders make informed decisions related to business growth, investment, capacity planning, and infrastructure development. Using data analytics and visualization tools like Tableau, the dataset can be analyzed to identify trends and patterns in the air transportation network, providing valuable insights into the state of the industry. This information can be used to optimize routes, improve operational efficiency, and enhance customer experience. Ultimately, the business requirement of the dataset is to enable stakeholders in the aviation industry to gain a competitive advantage by making data-driven decisions. By providing a comprehensive collection of data related to the air transportation network, the dataset can help stakeholders stay ahead of the curve in a dynamic and rapidly changing industry.

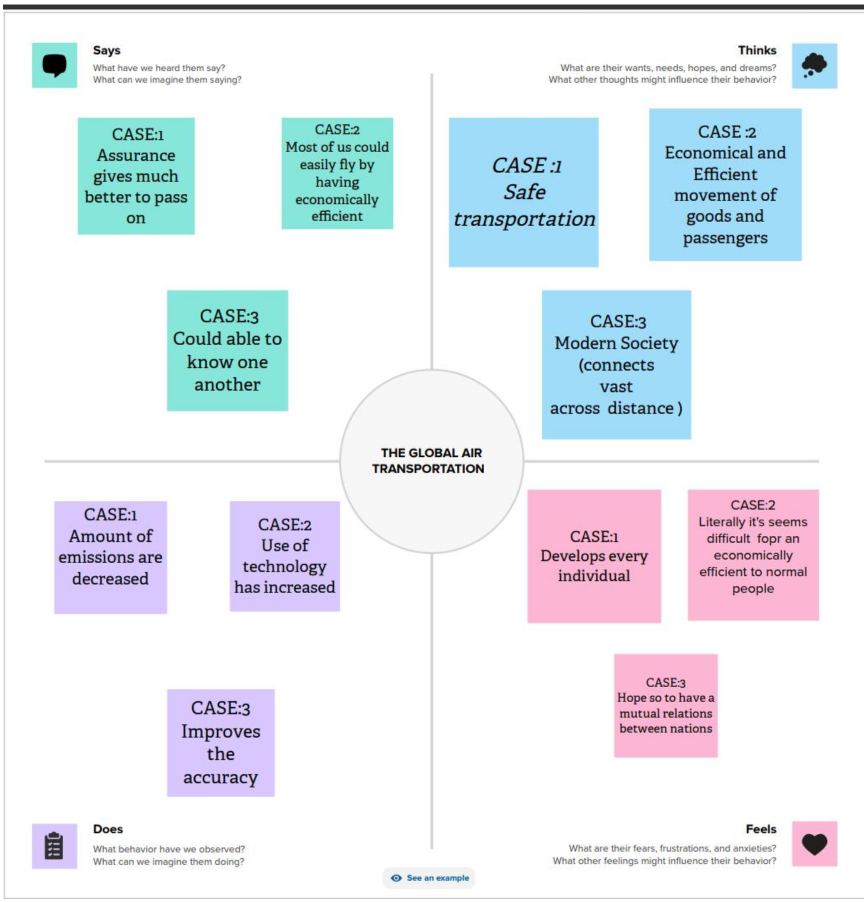
Literature Survey

A literature survey for Global Air Transportation Network involves reviewing academic articles, books, and other sources related to the aviation industry including statistical, economic, financial models. It also discusses various factors that affect the flight delay, flight route etc. The survey can provide a comprehensive understanding of the significance, challenges, and opportunities associated with the aviation industry.

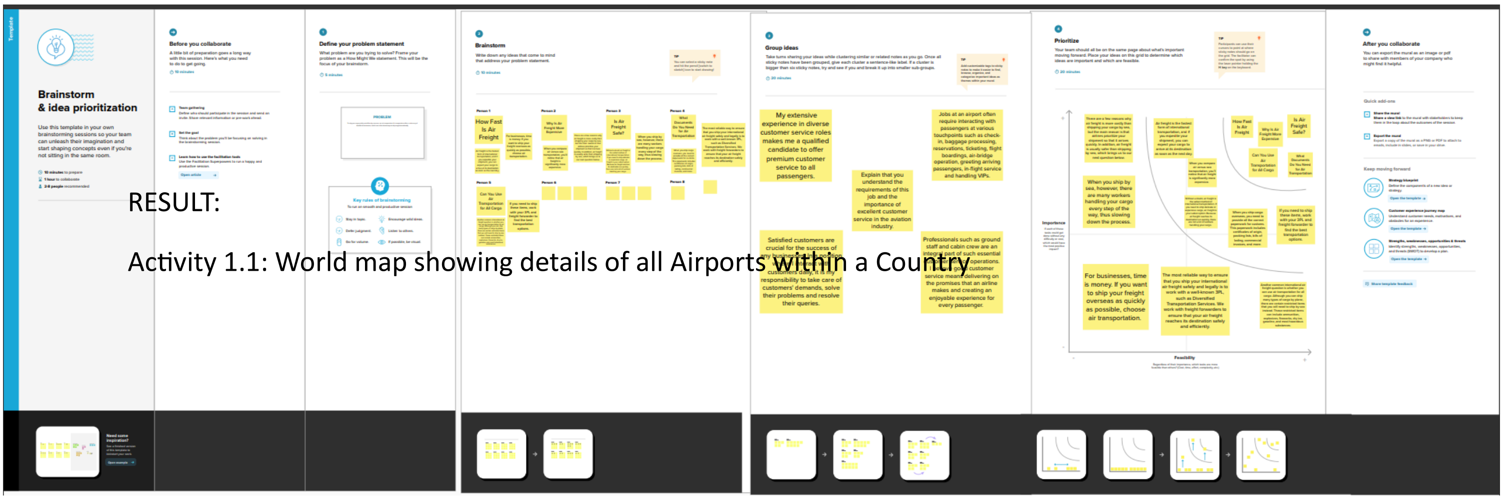
Social or Business Impact:

Socially, the dataset can contribute to the development of air transportation networks that are more efficient, safe, and environmentally sustainable. By providing stakeholders with a comprehensive understanding of the air transportation network, the dataset can help to optimize routes and reduce congestion in the air, leading to improved air quality and reduced carbon emissions. This can contribute to the overall well-being of communities around the world, by making air travel more accessible, affordable, and eco-friendly. From a business perspective, the dataset can have a significant impact on the aviation industry. By enabling stakeholders to make data-driven decisions, the dataset can help airlines, airport authorities, tourism boards, and government agencies to identify new business opportunities, optimize capacity planning, and streamline operations. This can lead to increased profitability and competitiveness, as well as improved customer experience. Moreover, the dataset can be used by investors to identify promising sectors and geographic areas for investment in the aviation industry.

2.1 EMPATHY MAP

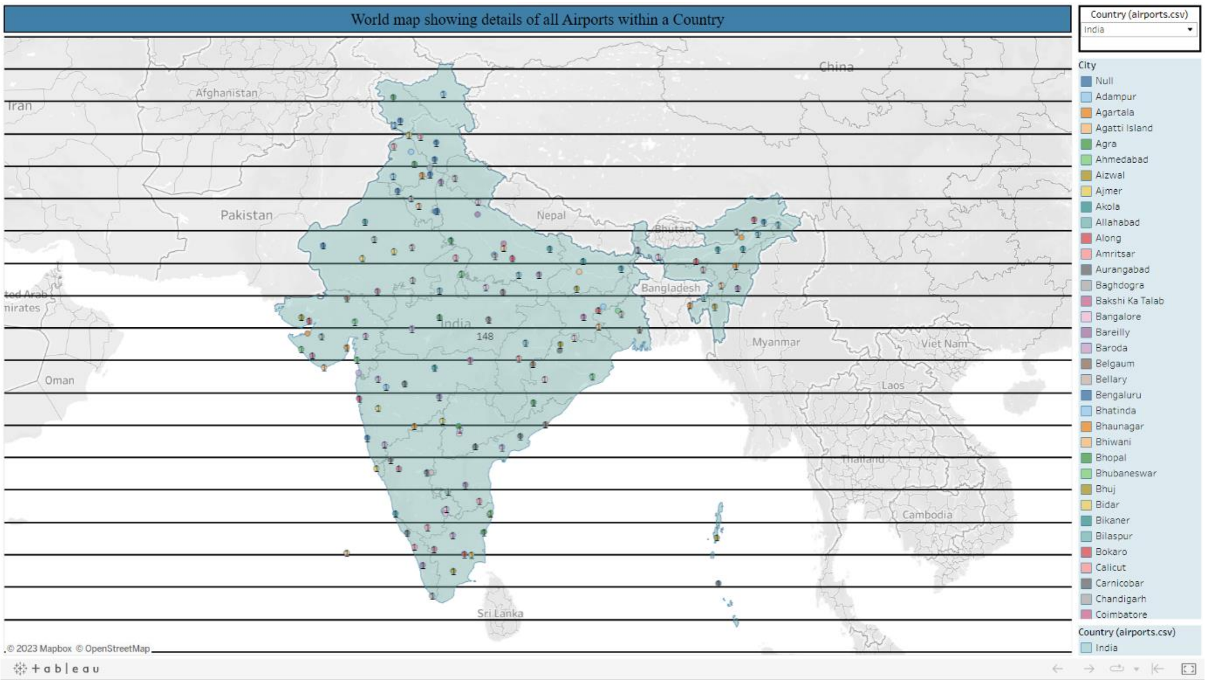


2.2 BRAINSTORMING



RESULT:

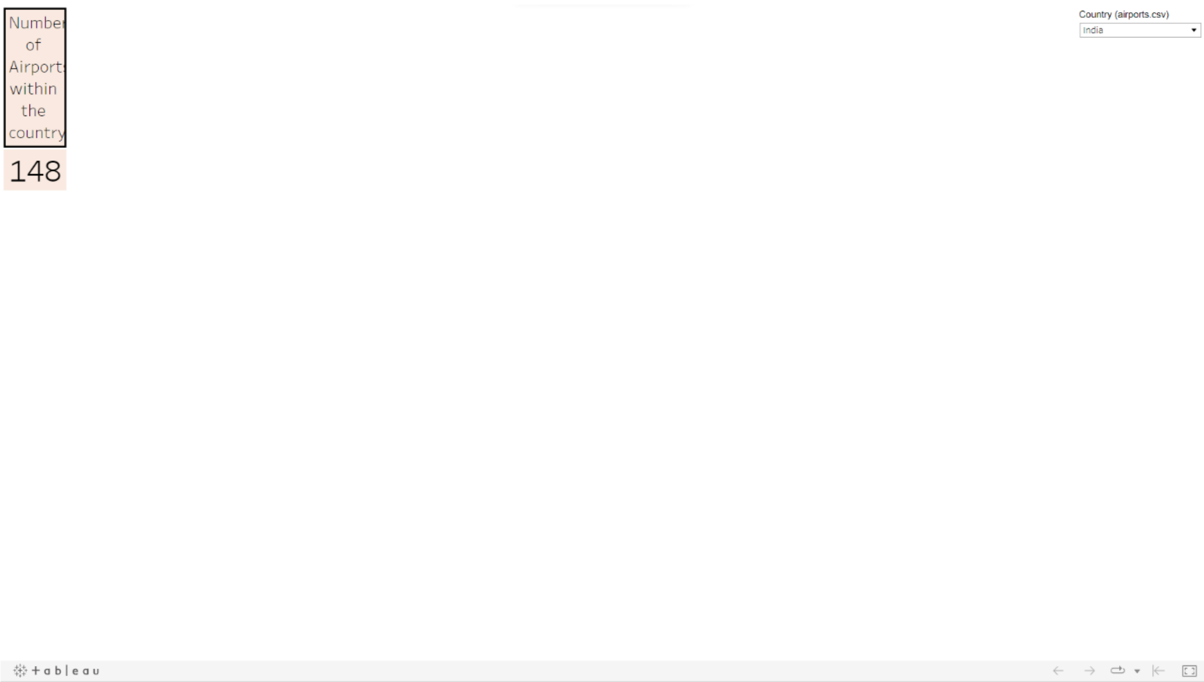
Activity 1.1: World map showing details of all Airports within a Country



Explanation video link:

https://public.tableau.com/views/sureka/WorldmapshowingdetailsofallAirportswithinaCountry?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

Activity 1.2: Number of Airports within the country



Explanation video link:

https://public.tableau.com/views/sureka/WorldmapshowingdetailsofallAirportswithinaCountry?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

Activity 1.3: Airports at Higher altitude within a country

Airports at Higher altitude within a country				
index no.	Name (air..	City	ICAO (airports.csv)	
1	Tomanggong Airport	Tomanggong	WBKM	26
	Tawau Airport	Tawau	WBKW	57
	Sultan Mahmud Airport	Kuala Terengganu	WMKN	21

Country (airports.csv)
Malaysia

Explanation video link:

https://public.tableau.com/views/sureka/AirportsatHigheraltitudewithinacountry?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

Activity 1.4: Airports at Higher altitude in the world

Airports at Higher altitude in the world			
Name (airports.csv)	City	ICAO (airports.csv)	
Golog Maqin Airport	Golog	ZLGL	12,426
Inca Manco Capac International Airport	Juliaca	SPJL	12,552
Copacabana Airport	Copacabana	SLCC	12,591
Yushu Batang Airport	Yushu	ZYLS	12,816
Capitan Nicolas Rojas Airport	Potosi	SLPO	12,913
El Alto International Airport	La Paz	SLLP	13,355
Ngari Gunsa Airport	Shiquanhe	ZUAL	14,022
Kangding Airport	Kangding	ZUKD	14,042
Qamdo Bangda Airport	Bangda	ZUBD	14,219
Daocheng Yading Airport	Daocheng	ZUDC	14,472

Explanation video link:

https://public.tableau.com/views/sureka/AirportsatHigheraltitudeintheworld?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

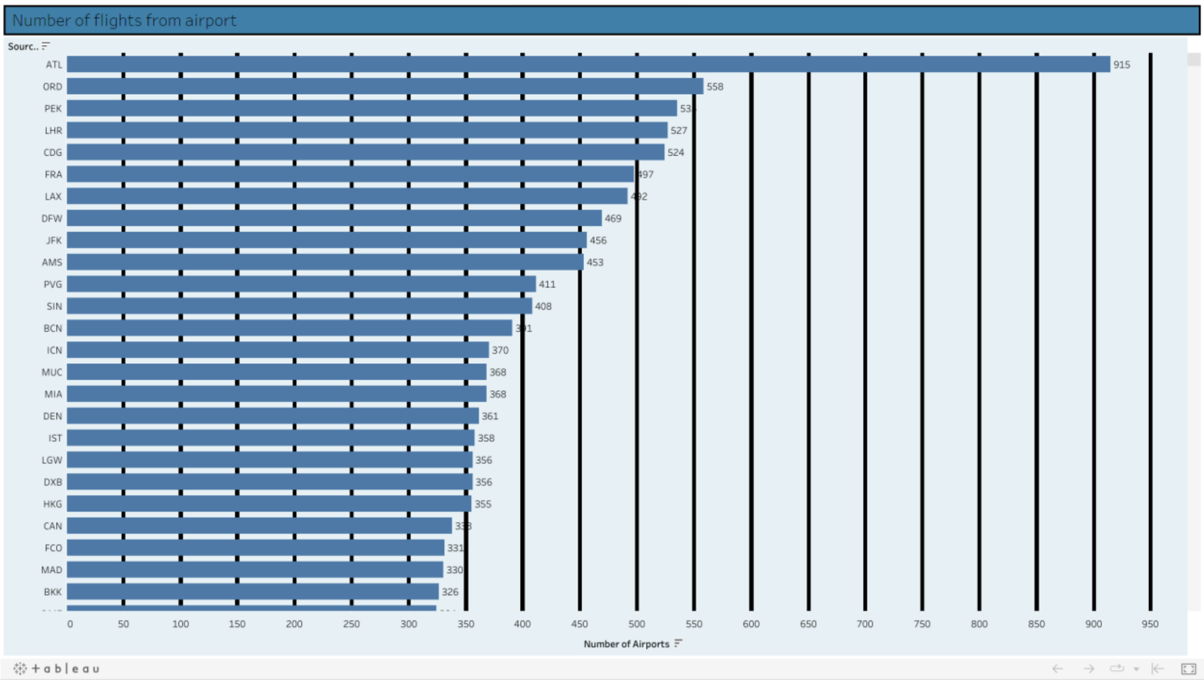
Activity 1.5: Airlines within a Country

Airline ID	Name	Icao	Callsign
921	Air Greenland	GRL	GREENLAND
1781	Cimber Air	CIM	CIMBER
1954	DAT Danish Air Transport	DTR	DANISH
3366	Maersk	Null	Null
4776	Sterling Airlines	SNB	STERLING
11856	Transavia Denmark	TDK	Null
17115	Copenhagen Express	CX0	Copex

Explanation video link:

https://public.tableau.com/views/sureka/AirlineswithinaCountry?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

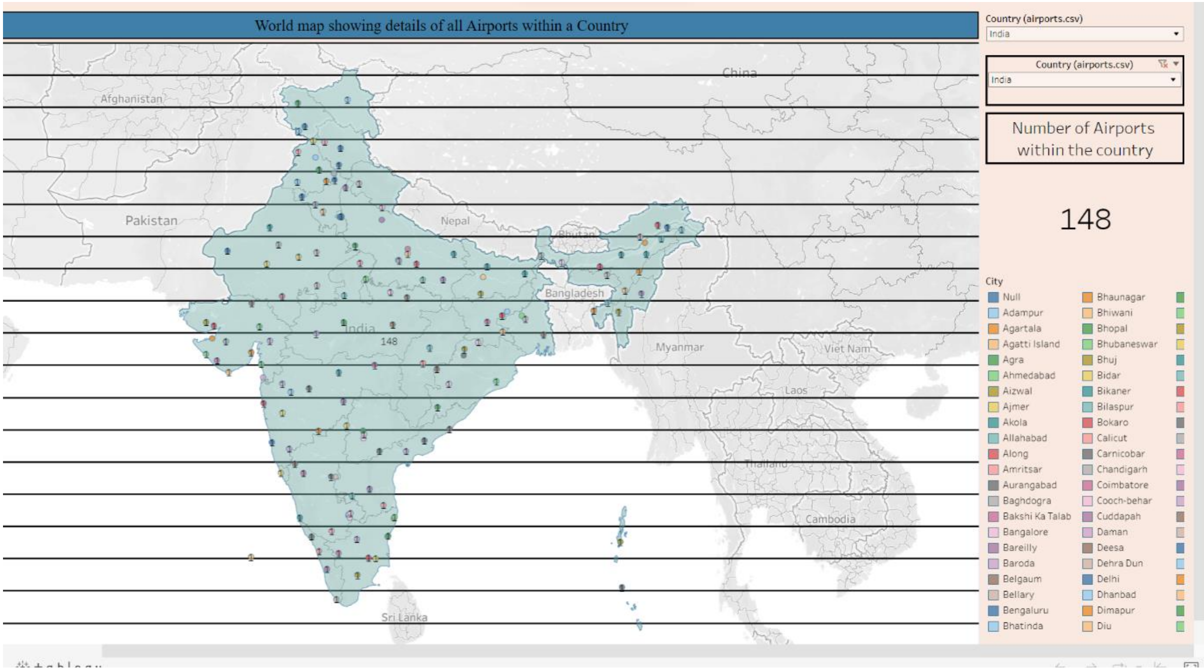
Activity 1.6: Number of flights from airport



Explanation video link:

https://public.tableau.com/views/sureka/Numberofflightsfromairport?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

ACTIVITY 1.7: DASHBOARD 1



EXPLANATION VIDEO LINK :

https://public.tableau.com/views/sureka/Dashboard1?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

ACTIVITY 1.8: DASHBOARD 2

Airlines within a Country

Airline ID	Name	Icao	Callsign
921	Air Greenland	GRL	GREENLAND
1781	Cimber Air	CIM	CIMBER
1954	DAT Danish Air Transport	DTR	DANISH
3366	Maersk	Null	Null
4776	Sterling Airlines	SNB	STERLING
11856	Transavia Denmark	TDK	Null
17115	Copenhagen Express	CXO	Copex

Active
(All)
N
Y

Country
Denmark

Active
Y

EXPLANATION VIDEO LINK:

https://public.tableau.com/views/sureka/Dashboard2?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

ACTIVITY 1.9: DASHBOARD 3

Airports at Higher altitude within a country

Country (airports.c: Malaysia

index no.	Name (air..	City	ICAO (airports.csv)	
1	Tomanggong Airport	Tomanggong	WBKM	26
	Tawau Airport	Tawau	WBKW	57
	Sultan Mahmud Airport	Kuala Terengganu	WMKN	21

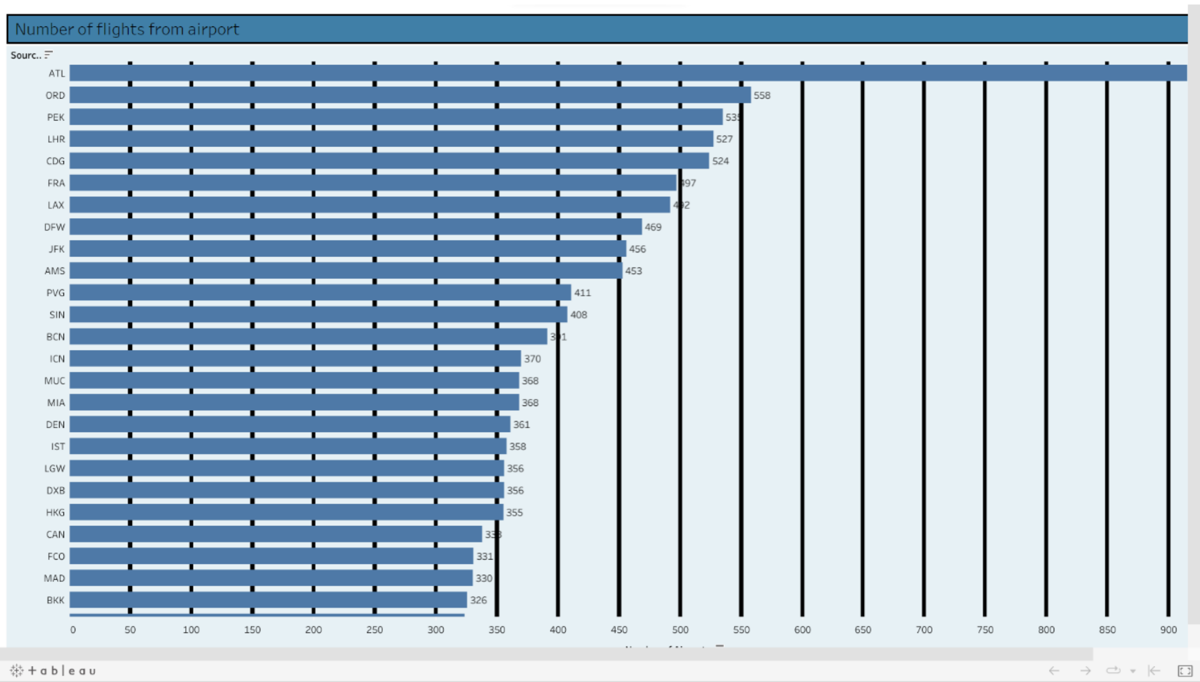
Airports at Higher altitude in the world

Name (airports.csv)	City	ICAO (airports.csv)	
Golog Maqin Airport	Golog	ZLGL	12,426
Inca Manco Capac International Airport	Juliaca	SPJL	12,552
Copacabana Airport	Copacabana	SLCC	12,591
Yushu Batang Airport	Yushu	ZYLS	12,816
Capitan Nicolas Rojas Airport	Potosi	SLPO	12,913
El Alto International Airport	La Paz	SLLP	13,355
Ngari Gunsa Airport	Shiquanhe	ZUAL	14,022
Kangding Airport	Kangding	ZUKD	14,042

EXPLANATION VIDEO LINK:

https://public.tableau.com/views/sureka/Dashboard3?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

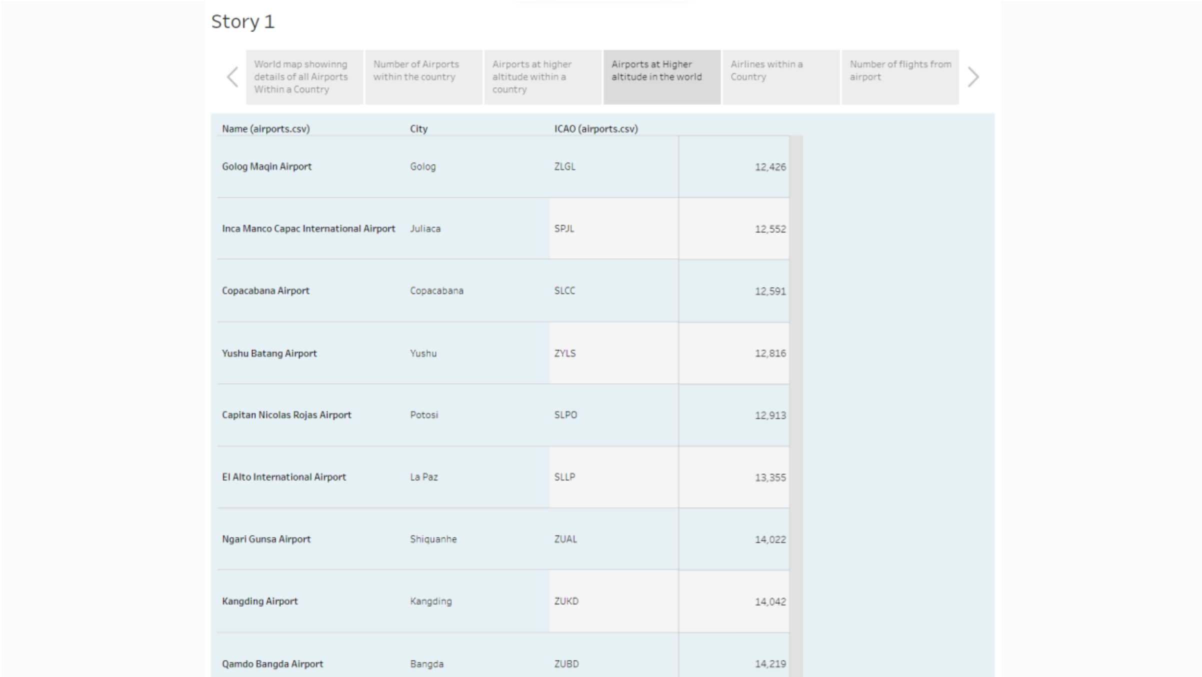
ACTIVITY 1.10: DASHBOARD 4



EXPLANATION VIDEO LINK :

https://public.tableau.com/views/sureka/Dashboard4?:language=en-US&publish=yes&:display_count=n&:origin=viz_share_link

ACTIVITY 1.11 : STORY



Name (airports.csv)	City	ICAO (airports.csv)	
Golog Maqin Airport	Golog	ZLGL	12,426
Inca Manco Capac International Airport	Juliaca	SPJL	12,552
Copacabana Airport	Copacabana	SLCC	12,591
Yushu Batang Airport	Yushu	ZYLS	12,816
Capitan Nicolas Rojas Airport	Potosi	SLPO	12,913
El Alto International Airport	La Paz	SLLP	13,355
Ngari Gunsa Airport	Shiquanhe	ZUAL	14,022
Kangding Airport	Kangding	ZUKD	14,042
Qamdo Bangda Airport	Bangda	ZUBD	14,219

4.ADVANTAGES AND DISADVANTAGES OF THE PURPOSED SOLUTION:

ADVANTAGES:

Fast delivery times

Undoubtedly, one of the most advantageous features offered by air transport is its **speedy delivery times**.

There is no faster transport service than air transport. In addition, the frequency of flights makes delivery times very frequent and fast.

No Physical Limits

Air transport is the only means of transportation that **does not support physical limits**. Road transport, for example, must undergo different physical constraints that slow down delivery times.

It is one of the means of transportation that offers practically no interruption in its services, which is very attractive for companies.

Very reliable transportation

One of the great advantages of air transport for both passengers and goods is its great **reliability**.

Delays in delivery dates or loss of goods are options that can be very difficult to achieve with this means of transport.

Long DistancesNo other means of transport in the logistics sector can **cover** such **long distances** as air transport. This is a **great advantage for international trade**, being able to cover long distances, impossible for road or sea transport.

DISADVANTAGES:

Higher Cost

There is no doubt that air transport is the least economical means of transportation compared to other types of transport.

The cost of infrastructure, fuel… makes air transport economically superior to other alternatives.

It is important to know how to analyze and calculate the economic and logistical performance to know if it is the ideal option to be used.

Less storage capacity

Storage capacity is lower than land and sea transport. This is a clear disadvantage, air transport is ideal for medium or low loads, but is not so attractive for large volumes of goods.

Restrictions on goods

Air transport, due to its specific characteristics, cannot carry certain products or goods. It suffers from certain restrictions, especially in liquid products such as petroleum, oils, etc…

5.APPLICATION:

Air transport is an important enabler to achieving economic growth and development. Air transport facilitates integration into the global economy and provides vital connectivity on a national, regional, and international scale. It helps generate trade, promote tourism, and create employment opportunities. The World Bank has financed aviation-related projects for over sixty years. Today, the WBG remains actively engaged in every region on projects related to air transport policy and regulation, safety, infrastructure rehabilitation, institutional strengthening, and capacity building.

6.CONCLUSION:

There is an increasing demand for computer science domain knowledge in the airline industry to conduct adequate data analysis. However, not much work has been done to consolidate this field across the various sectors of the industry. Thus, the airlines have yet to fully realize the benefits of embracing cutting-edge ML techniques for data analytics. To the best of our knowledge, this is the first comprehensive work that presents a multi-perspective look into the details of how ML is being applied to analyze airlines' data.

This article provides a detailed review of the state-of-the-art AI applications for data analytics in the most fundamental aspects of the airline domain. The authors investigate how the introduction of the free market stimulates the development of the airline industry after the Airline Deregulation Act of 1978; moreover, how computer science gradually becomes involved within the industry through the application of advanced ML techniques. Major studies involving critical components of the airline industry were identified along with frameworks and popular techniques in both traditional and ML domains. The most popular ML algorithms and models tested in the airline industry are presented. Moreover, a comprehensive list of datasets and data sources is provided. Although most of the sources in this list are public, several commercial or private data sources are also included based on the impact and frequency of their respective research references.

ML has the potential to deliver substantial impact based on the following challenges and future research directions:

- The traditional analytic approach has dominated the ancillary price optimization problem. Advanced ML methods can provide essential techniques to solve the mixed bundles and correlated reservation prices problem.
- ML recommendation system has been deployed in many fields, such as online retail and video streaming services, with great success. Air travel products and services can benefit the revenue generated through these sophisticated recommendation systems.
- With the help of advanced ML techniques (e.g., deep learning), the airline industry can leverage large amounts of data from different sources to generate better strategies and further improve the overall performance of their operations. Techniques such as deep customer opinion analysis and deep RL can assist the industry to better adapt to the dynamic market.

We hope this survey provides readers with a comprehensive understanding of the relationship between the airline industry and data analytics and sheds light on future research directions and opportunities.

7.FUTURE SCOPE:

Data analytics and ML provide excellent opportunities for the airline industry to improve their products and operations. Despite the vast amounts of available data and the advanced tools that have been developed in the last decades, the airline industry applications, as well as ML techniques used in this domain, are still limited. In this section, we discuss possible future directions and avenues of data analytics research using data from the airline industry. Specifically, future directions are divided into airline applications and advanced ML techniques.

5.1 Airline Applications

5.1.1 *Ancillary Service Optimization.* Industries using RM have witnessed the significant boost in revenue that is being generated through the sale of ancillary services. The airline industry is a prime example, offering unbundled services such as reserved seats, priority boarding, in-flight food/beverage, checked luggage, and more. demonstrate the steady increase in revenue for three major air carriers in regards to two essential ancillary-based products: (1) checked baggage and reservation change or cancelation. However, the prices for these unbundled items are not optimized, causing airlines to miss significant revenue opportunities. With the recent success of unbundled items, optimization models for ancillary revenue are getting an increasing amount of attention. A recent work by Navitaire, known as APO, is a good example of how the industry is starting to see the benefits of applying ML techniques to dynamically decide prices for ancillary products. As Identified by Fiig et al, two possible research directions regarding the ancillary revenue optimization can be suggested for the future work:

(1) mixed bundles and

(2) correlated reservation prices.

Mixed Bundles: . Companies can sell products separately (*a la carte*), as one entity (pure bundles), or as a component mix of two options (mixed bundles). The choice between these categories requires an internal pricing consistency. Mixed bundling has been proven to be an optimal approach to making more revenue rather than relying on pure bundling. Nonetheless, the choice of bundles for maximizing revenue has been shown to be NP-hard when allowing more than two items in the same bundle. Therefore, future research on mixed bundling should focus on more efficient and practical data-driven solutions for maximizing the revenue.

Correlated Reservation Prices: . As of today, the fares for a customer's different itineraries are determined simultaneously. This is achieved through the advent of the fare adjustment theory. The current challenge is to determine the prices for all correlated ancillary products simultaneously. A recent study by Bockelie and Belobaba proposed an **Ancillary Choice Model (ACM)** by integrating passenger choice-models for the itinerary, fare class, and ancillary service. ACM serves to define the consumers' selection of specific ancillary services after deciding their preferred airline itinerary along with the fare class. Airlines have recently noted the benefits of employing the decoy effect to better predict customer choice and drive up sales. However, a comprehensive study is demanding to explain how the decoy effect can be modeled for the ancillary pricing optimization and analyze its benefits and limitations. In the future, ML and deep learning can be used to automatically model the passenger choices of ancillary services .

5.1.2 *Recommender Systems.* A recommender system can make suggestions that will appeal to users, giving them support during the decision-making process. It requires rich information on users, items, and the users' shopping patterns, along with domain knowledge of the underlying behavioral process that led to a specific decision. AI-supported recommendation systems are essential for web-applications and OTAs, and must rapidly and accurately infer these patterns from the users in near real-time. By combining merchandising techniques (the way an offer is presented), psychological factors (how the user responds to the offer) and ML methods, companies can train models that generalize the process and automatically predict the users' preferred products and services . A good example is the use of sentiment analysis on consumer reviews to identify the airline services users recommend. A study by Siering et al. provides a look into which airline service consumers pay more attention to and how these factors explain a consumer's recommendation by making use of sentence-level sentiment polarity. Recently, Mottini et al. introduced a novel benchmark on three choice-model methods (traditional, ML-based, and deep learning-based) to identify the most suitable approach for the recommender problem.

5.2 Advanced Machine Learning Techniques

Despite the great success of ML and DL in recent years and the increasing role of AI in many industrial applications, there are still considerably few ML techniques applied to the airline's applications. Nevertheless, many airlines have planned to leverage AI and more advanced ML techniques in the near future to address the existing challenges in dynamic pricing, ancillary service optimization, overbooking, EMSR, WTP, and costumers' feedback analysis. An example of these techniques includes ensemble learning models for automatic air ticket pricing, as suggested by Abdella et al. In addition, more reecently, **Multi-Agent Systems (MAS)** have attracted significant attention in the airline industry. MAS has been studied for two decades to tackle congestion problems in the transportation domain. However, there are still very few research studies using MAS to solve demand and capacity imbalance problems that are essential to solve in the airline industry. In the case of RM, deep RL, combining both DL and RL, has the capability of adapting to a dynamically changing environment. Airline RM could leverage techniques from Reference , where a deep multi-agent RL model is developed for maximizing the gross merchandise volume of the large-scale ride-sharing car fleet. Also, the idea of using RL for energy consumption schedulingcan be borrowed to solve the issue of dynamic pricing and energy consumption for the airlines. In terms of the importance of fairness in the airline marketplace, DRL can be considered in the future to develop dynamic pricing strategies .

Moreover, it is apparent there are limited numbers of advanced deep learning techniques for sentiment and opinion mining in the airline industry. Sentiment mining for airline reviews can benefit from advanced techniques proposed by Tang et al. , which utilized Convolutional Neural Network and LSTM networks on online reviews and even introduced a novel network that integrates the semantic representations of user and product information. Multi-aspect level sentiment analysis also contributes essential information for companies to gain a comprehensive understanding of the customers' perception of their services and products. The recently introduced attention mechanism has been advantageous for aspect-level representations of documents.

DL also shows great potential in analyzing time-series data, which are commonly seen in the airline industry. Recently, Li and Cao proposed to use LSTM to predict the tourism flow in local landscapes, while Silva et al.proposed to apply autoregressive neural networks to estimate the tourism demand in multiple countries in Europe. Both methods achieve better performance than conventional methods. In the airline industry, the estimation of customer demand and O-D flow tackles very similar problems, and the performance of these problems can be potentially improved in the future with the help of DL. Moreover, other topics in this industry, such as ticket pricing and simulation tools, are built upon the demand and O-D flow prediction and thus benefit from deep neural networks as well.

8.APPENDIX:

- **http://www.ideaworkscompany.com/wp-content/uploads/2017/11/Press-Release-123-Global-Estimate.pdf**.
- **https://navitaire.com/Styles/Images/PDFs/APO_Whitepaper.pdf**.
- **https://amadeus.com/en/insights/white-paper/the-importance-of-understanding-travelers-motivation**.
- **https://amadeus.com/en/insights/blog/ancillary-revenue-coming-soon-around-the-world**.
- **http://www.wsj.com/articles/SB10001424052748703819904574555701528290902**.
- **airlinemeals.net**.
- Website for airline, airport, and associated air travel traveler reviews: **skytrax.com**.
- **www.transtats.bts.gov**.
- Data from BTS, Form 41 Financial Reports.
- **https://www.altexsoft.com/blog/datascience/7-ways-how-airlines-use-artificial-intelligence-and-data-science-to-improve-their-operations**.