

# CIS 5200 Term Project Tutorial

## Flight Prices Analysis

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### 1. Objectives

In this hands-on lab, you will learn how to:

- Upload the data into HDFS using -put command.
- Create Hive tables and perform data engineering in Hive using HiveQL
- Query data using HiveQL
- Secure copy tables created with HiveQL from Hadoop to local computers
- Create visualizations

### 2. Platform Specifications

hdfs version

```
-bash-4.2$ hdfs version
Hadoop 3.1.2
Source code repository ssh://git@bitbucket.oci.oraclecorp.com:7999/bdcs/apache_bigtop.git -r 4100eb8d8581c4328601079ff5af522f95e9977f
Compiled by root on 2023-02-27T08:26Z
Compiled with protoc 2.5.0
From source with checksum b367ca15864aef16725a3035859c9ece
This command was run using /usr/odh/1.1.5/hadoop/hadoop-common-3.1.2.jar
```

lscpu

```
-bash-4.2$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:            Little Endian
CPU(s):                8
On-line CPU(s) list:  0-7
Thread(s) per core:   2
Core(s) per socket:   4
Socket(s):             1
NUMA node(s):          1
Vendor ID:             GenuineIntel
CPU family:            6
Model:                 85
Model name:            Intel(R) Xeon(R) Platinum 8167M CPU @ 2.00GHz
Stepping:               4
CPU MHz:               1995.312
BogoMIPS:              3990.62
Virtualization:        VT-x
Hypervisor vendor:     KVM
Virtualization type:   full
L1d cache:              32K
L1i cache:              32K
L2 cache:                4096K
L3 cache:                16384K
NUMA node0 CPU(s):      0-7
```

```
hdfs dfsadmin -report
```

```
-bash-4.2$ hdfs dfsadmin -report
Configured Capacity: 419520548352 (390.71 GB)
Present Capacity: 417859894557 (389.16 GB)
DFS Remaining: 42330897693 (39.42 GB)
DFS Used: 375528996864 (349.74 GB)
DFS Used%: 89.87%
Replicated Blocks:
    Under replicated blocks: 0
    Blocks with corrupt replicas: 0
    Missing blocks: 0
    Missing blocks (with replication factor 1): 0
    Low redundancy blocks with highest priority to recover: 0
    Pending deletion blocks: 0
Erasure Coded Block Groups:
    Low redundancy block groups: 0
    Block groups with corrupt internal blocks: 0
    Missing block groups: 0
    Low redundancy blocks with highest priority to recover: 0
    Pending deletion blocks: 0
-----
report: Access denied for user amach3. superuser privilege is required
```

- Cluster Version: Hadoop 3.1.2
- CPU Speed: 1995.312 MHz
- Number of CPU cores: 8 cores \* 5 nodes = 40 cores
- Number of nodes: 5 (2 Master and 3 Worker)
- Total Memory Size: 390.71 GB

### 3. Steps to download Kaggle datasets in Google Colab

(<https://www.kaggle.com/general/156610>)

**Note:** We realized the steps in this section are not necessary in this project. We could have downloaded the zip file directly from Kaggle then unzip the file on a local computer. You can move to section 4.

1. Go to your kaggle account, Scroll to API section and Click Expire API Token to remove previous tokens
2. Click on Create New API Token - It will download kaggle.json file on your machine.

## API

Using Kaggle's beta API, you can interact with Competitions and Datasets to download data, make submissions, and more via the command line. [Read the docs](#)

✓ Ensure kaggle.json is in the location `~/.kaggle/kaggle.json` to use the API.

[Dismiss](#)

[Create New Token](#)

[Expire Token](#)

Downloads		Date modified	Type	Size
<input type="checkbox"/>	Name			
▼ Today	kaggle	4/19/2023 8:55 PM	JSON Source File	1 KB

3. Go to your Google Colab project file and run the following commands to mount your Google Drive files Following code make mount your google drive

```
from google.colab import drive  
drive.mount('/content/gdrive')
```

The image shows a terminal window from Google Colab. It displays the command `from google.colab import drive` and `drive.mount('/content/gdrive')`. Below the command, the text "Mounted at /content/gdrive" is displayed, indicating the successful mounting of the Google Drive. A progress bar at the top left shows "21s" and a play button icon.

- Now upload the `kaggle.json` file

```
from google.colab import files  
files.upload() #this will prompt you to upload the kaggle.json
```

```
✓ 7s ⏎ from google.colab import files  
files.upload() #this will prompt you to upload the kaggle.json  
  
Choose Files kaggle.json  
• kaggle.json(application/json) - 62 bytes, last modified: 4/19/2023 - 100% done  
Saving kaggle.json to kaggle.json  
{'kaggle.json': b'{"username": "amach3", "key": "094e3731b85425bb83e0d949718917da"}'}
```

- make sure kaggle.json file is present

```
!ls -lha kaggle.json
```

```
✓ 0s ⏎ !ls -lha kaggle.json  
  
-rw-r--r-- 1 root root 62 Apr 20 04:08 kaggle.json
```

- Install kaggle API client

```
!pip install -q kaggle
```

```
✓ 4s ⏎ !pip install -q kaggle
```

- kaggle API client expects the file to be in ~/.kaggle
- so move it there

```
!mkdir -p ~/.kaggle
```

```
!cp kaggle.json ~/.kaggle/
```

```
✓ 0s ⏎ !mkdir -p ~/.kaggle  
!cp kaggle.json ~/.kaggle/
```

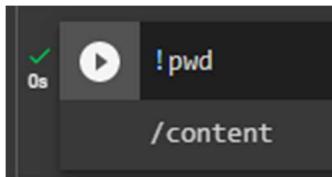
- we need to set permissions

```
!chmod 600 /root/.kaggle/kaggle.json
```

```
✓ 0s ⏎ !chmod 600 /root/.kaggle/kaggle.json
```

- check your directory before downloading the datasets

```
!pwd
```



- list all available datasets

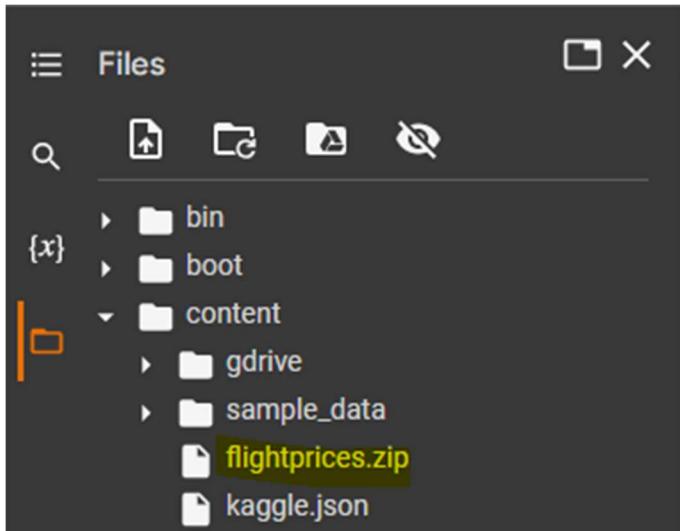
```
!kaggle datasets list
```

ref	title	size	lastUpdated	downloadCount	voteCount	usabilityRating
salvatorerastelli/spotify-and-youtube	Spotify and Youtube	9MB	2023-03-20 15:43:25	8181	301	1.0
ppb00x/country-gdp	Country GDP	7KB	2023-04-07 06:47:36	1090	34	1.0
erdemtaha/cancer-data	Cancer Data	49KB	2023-03-22 07:57:00	3554	82	1.0
omartorres25/honda-data	Honda Cars Data	184KB	2023-03-28 04:19:11	1254	31	1.0
lokeshparab/amazon-products-dataset	Amazon Products Sales Dataset 2023	80MB	2023-03-26 10:45:19	3981	83	1.0
ulrikhthegeddersen/fastfood-nutrition	Fastfood Nutrition	12KB	2023-03-21 10:02:41	3285	65	1.0
rkiattisak/student-performance-in-mathematics	Student performance prediction	9KB	2023-03-12 04:32:56	8949	188	1.0
ppb00x/credit-risk-customers	credit_risk_customers	18KB	2023-04-12 08:28:28	1147	34	1.0
arnabchakli/data-science-salaries-2023	Data Science Salaries 2023	25KB	2023-04-13 09:55:16	1615	42	1.0
kapturovalexander/nvidia-amd-intel-asus-msi-share-prices	NVIDIA, AMD, Intel, ASUS, MSI share prices (GPU)	902KB	2023-04-13 12:15:18	475	33	1.0
ashishraut64/internet-users	Global Internet users	163KB	2023-03-29 12:25:13	2229	56	1.0
rkiattisak/smart-watch-prices	Smart Watch prices	5KB	2023-04-12 06:04:23	609	23	1.0
arnabchakli/popular-video-games-1980-2023	Popular Video Games 1980 - 2023	1MB	2023-03-23 16:16:51	3847	107	1.0
ashishraut64/global-methane-emissions	Global Emissions	31KB	2023-03-27 09:02:51	2787	57	1.0
tayyarhussain/best-selling-game-consoles-of-all-time	Best-Selling Gaming Consoles Dataset	1KB	2023-04-01 10:59:00	1011	34	1.0
shrutiambekar/mobile-phone-specifications-and-prices-in-india	Smartphone Specifications and Prices in India	36KB	2023-04-13 06:13:13	453	22	1.0
kapturovalexander/bitcoin-and-ethereum-prices-from-start-to-2023	Bitcoin & Ethereum prices (from start to 2023)	149KB	2023-04-06 06:07:57	824	30	1.0
richardson/the-world-university-rankings-2011-2023	THE World University Rankings 2011-2023	1MB	2023-04-03 12:43:37	1954	45	1.0
dgoemrique/netflix-movies-and-tv-shows	Netflix Movies and TV Shows	2MB	2023-03-13 18:49:00	3940	97	1.0
dansbecker/melbourne-housing-snapshot	Melbourne Housing Snapshot	451KB	2018-06-05 12:52:24	113094	1247	0.7058824

- download the required dataset from kaggle by copying the API command from the dataset page (<https://www.kaggle.com/datasets/dilwong/flightprices?select=itineraries.csv>)

```
!kaggle datasets download -d dilwong/flightprices
```

```
54s  ⏴ !kaggle datasets download -d dilwong/flightprices  
      Downloading flightprices.zip to /content  
      100% 5.50G/5.51G [00:53<00:00, 98.7MB/s]  
      100% 5.51G/5.51G [00:54<00:00, 110MB/s]
```



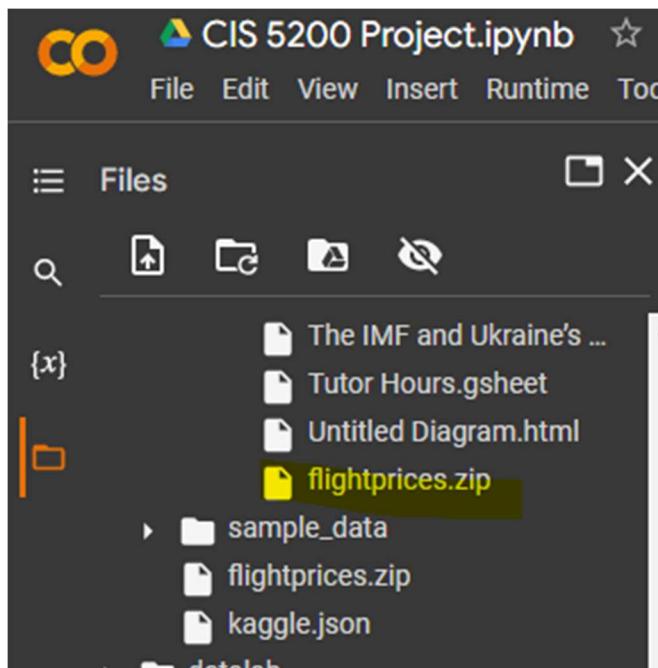
- check if the zip file is in the current working directory

```
0s  ⏴ !ls -al  
      total 5782032  
      drwxr-xr-x 1 root root      4096 Apr 20 04:16 .  
      drwxr-xr-x 1 root root      4096 Apr 20 04:01 ..  
      drwxr-xr-x 4 root root     4096 Apr 18 22:00 .config  
      -rw-r--r-- 1 root root 5920770411 Apr 20 04:17 flightprices.zip  
      drwx----- 5 root root     4096 Apr 20 04:03 gdrive  
      -rw-r--r-- 1 root root      62 Apr 20 04:08 kaggle.json  
      drwxr-xr-x 1 root root     4096 Apr 18 22:00 sample_data
```

- Copy the zip file to Google Drive

```
!cp flightprices.zip /content/gdrive/MyDrive
```

```
45s  ⏴ !cp flightprices.zip /content/gdrive/MyDrive
```



#### 4. Secure copy csv files from my local computer to Linux server

- Download the flightprices.zip file from Google Drive then unzip it in Download folder, then secure copy it to tmp folder on Linux server.

```
scp -C C:/Users/jiazh/Downloads/flightprices/itineraries.csv amach3@144.24.53.159:/tmp
```

```
jiazh@LAPTOP-2FFALVQG MINGW64 ~
$ scp -C C:/Users/jiazh/Downloads/flightprices/itineraries.csv amach3@144.24.53.159:/tmp/
amach3@144.24.53.159's password:
itineraries.csv                                         100%   29GB    6.9MB/s 1:11:44
```

- Download the airport.csv file from Kaggle and unzip it in Download folder. Then secure copy it to linux.

```
scp C:/Users/jiazh/Downloads/airportcode/airports.csv amach3@144.24.53.159:/home/amach3
```

```
jiazh@LAPTOP-2FFALVQG MINGW64 ~
$ scp C:/Users/jiazh/Downloads/airportcode/airports.csv amach3@144.24.53.159:/home/amach3
amach3@144.24.53.159's password:
airports.csv                                         100%   567KB  809.9KB/s  00:00
```

#### 5. Copy files from linux server to hdfs

- Make FlightData directory and put itineraries.csv file here

```
hdfs dfs -mkdir FlightData
```

```
hdfs dfs -put /tmp/itineraries.csv /user/amach3/FlightData/
```

```
hdfs dfs -ls FlightData/
```

```
-bash-4.2$ hdfs dfs -ls FlightData/
Found 1 items
-rw-r--r-- 3 amach3 hdfs 31091834438 2023-04-23 14:55 FlightData/itineraries.csv
bash-4.2$ |
```

- Make the FlightData directory public

```
hdfs dfs -chmod -R go+rx /user/amach3/FlightData
```

- Make Airport directory and put Airport.csv file here

```
hdfs dfs -mkdir Airport
```

```
hdfs dfs -put airports.csv Airport/
```

```
hdfs dfs -ls Airport/
```

```
-bash-4.2$ hdfs dfs -mkdir Airport
hdfs dfs -ls Airport/
-bash-4.2$ hdfs dfs -put airports.csv Airport/
-bash-4.2$ hdfs dfs -ls Airport/
Found 1 items
-rw-r--r-- 3 amach3 hdfs      580468 2023-04-21 03:49 Airport/airports.csv
-bash-4.2$ |
```

- make the Airport directory public

```
hdfs dfs -chmod -R go+rx /user/amach3/Airport
```

## 6. Create tables in Hive

```
Beeline
```

```
Use amach3;
```

```
DROP TABLE IF EXISTS Airport;
```

```
CREATE EXTERNAL TABLE IF NOT EXISTS Airport
```

```
(Name string, City string, Country string, IATA string, ICAO string,  
Latitude double, Longitude double)
```

```
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
```

```
STORED AS TEXTFILE LOCATION '/user/amach3/Airport/'
```

```
TBLPROPERTIES ('skip.header.line.count='1');
```

```
SELECT * FROM Airport LIMIT 10;
```

airport.name	airport.city	airport.country	airport.iata	airport.icao	airport.latitude	airport.longitude
Goroka Airport	Goroka	Papua New Guinea	GKA	AYGA	-6.081689835	145.3919983
Madang Airport	Madang	Papua New Guinea	MAG	AYMD	-5.207079887	145.7890015
Mount Hagen Kagamuga Airport	Mount Hagen	Papua New Guinea	HGU	AYMH	-5.826789856	144.2960052
Nadzab Airport	Nadzab	Papua New Guinea	LAE	AYNZ	-6.569803	146.725977
Port Moresby Jacksons International Airport	Port Moresby	Papua New Guinea	POM	AYPY	-9.443380356	147.2200012
wewak International Airport	Wewak	Papua New Guinea	WWK	AYWK	-3.583830118	143.6690063
Narsarsuaq Airport	Narsarsuaq	Greenland	UAK	BGBW	61.16049957	-45.42599869
Godthaab / Nuuk Airport	Godthaab	Greenland	GOH	BGCH	64.19090271	-51.67810059
Kangerlussuaq Airport	Sondrestrom	Greenland	SFJ	BGSF	67.0122219	-50.71160316
Thule Air Base	Thule	Greenland	THU	BGTL	76.53119659	-68.70320129

```
DROP TABLE IF EXISTS FlightData;
```

```
CREATE EXTERNAL TABLE IF NOT EXISTS FlightData
```

```
(FlightID string, SearchDate date, FlightDate date, StartingAirport string,  
DestinationAirport string, FareBasisCode string, TravelDuration string,  
ElapsedDays int, IsBasicEconomy boolean, IsRefundable boolean,  
IsNonStop boolean, BaseFare double, TotalFare double, SeatsRemaining int,  
TotalTravelDistance double, SegmentsDepartureTimeEpochSeconds string,  
SegmentsDepartureTimeRaw string, SegmentsArrivalTimeEpochSeconds string,  
SegmentsArrivalTimeRaw string, SegmentsArrivalAirportCode string,  
SegmentsDepartureAirportCode string, SegmentsAirlineName string,  
SegmentsAirlineCode string, SegmentsEquipmentDescription string,  
SegmentsDurationInSeconds string, SegmentsDistance double,  
SegmentsCabinCode string)
```

```
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
```

```
STORED AS TEXTFILE LOCATION '/user/amach3/FlightData/'
```

```
TBLPROPERTIES ('skip.header.line.count='1');
```

```
SELECT * FROM FlightData LIMIT 2;
```

flightdata.flightid	flightdata.searchdate	flightdata.fligthdate	flightdata.startingairport	flightdata.destinationairport	flightdata.farebasiscode	flightdata.travelduration	flightdata.elapseddays	flightdata.isbasicconomy	flightdata.isrefundable	flightdata.isnonstop	flightdata.basefare	flightdata.totalfare	flightdata.seatsremaining	flightdata.totaltraveldistance	flightdata.segmentsdeparturetimeepochseconds	flightdata.segmentsarrivaltimetimeraw	flightdata.segmentsdepartureairportcode	flightdata.segmentsarrivalairportcode	flightdata.segmentsairlinename	flightdata.segmentsairlinecode	flightdata.segmentsequipmentdescription	flightdata.segmentsdurationinseconds	flightdata.segmentsdistance	flightdata.segmentscabincode
9cae081111c683be1012473feefdf28f   2022-04-16   2022-04-17   ATL   BOS   LAONXOMC   9   PT2H29M	0   1650214620   false   true   Delta   248.6   2022-04-17T15   Airbus A321	:26:00.000-04:00   BOS   8940   947.0   2022-04-16   2022-04-17   ATL   coach   BOS   LAONXOMC   4   PT2H30M   2022-04-17T09   Airbus A321	947.0   1650191400   false   true   Delta   248.6   2022-04-17T06:30:00.000-04:00   1650200400   DL	0   9000   947.0   2022-04-16   2022-04-17   ATL   coach   BOS   LAONXOMC   9   PT2H29M   2022-04-17T15   Airbus A321																				
98685953630e772a098941b71906592b   2022-04-16   2022-04-17   ATL   BOS   LAONXOMC   4   PT2H30M	0   1650214620   false   true   Delta   248.6   2022-04-17T06:30:00.000-04:00   1650223560   DL	:00:00.000-04:00   BOS   8940   947.0   2022-04-16   2022-04-17   ATL   coach   BOS   LAONXOMC   9   PT2H29M   2022-04-17T15   Airbus A321	947.0   1650191400   false   true   Delta   248.6   2022-04-17T06:30:00.000-04:00   1650200400   DL	0   9000   947.0   2022-04-16   2022-04-17   ATL   coach   BOS   LAONXOMC   9   PT2H29M   2022-04-17T15   Airbus A321																				
2 rows selected (0.324 seconds)																								

Since the dataset is too large, Dr. Woo advised us to reduce our data size to 2 – 3 GB by sampling our data.

```
select count(*) from FlightData; --82138753 rows
```

--10% is about 8,000,000 rows

```
CREATE EXTERNAL TABLE IF NOT EXISTS FlightData2
(FlightID string, SearchDate date, FlightDate date, StartingAirport string,
DestinationAirport string, FareBasisCode string, TravelDuration string,
ElapsedDays int, IsBasicEconomy boolean, IsRefundable boolean,
IsNonStop boolean, BaseFare double, TotalFare double, SeatsRemaining int,
TotalTravelDistance int, SegmentsDepartureTimeEpochSeconds string,
SegmentsDepartureTimeRaw string, SegmentsArrivalTimeEpochSeconds string,
SegmentsArrivalTimeRaw string, SegmentsArrivalAirportCode string,
SegmentsDepartureAirportCode string, SegmentsAirlineName string,
SegmentsAirlineCode string, SegmentsEquipmentDescription string,
SegmentsDurationInSeconds string, SegmentsDistance int,
SegmentsCabinCode string)
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
STORED AS TEXTFILE LOCATION '/user/amach3/FlightData2/'
TBLPROPERTIES ('skip.header.line.count'='1');
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
select * from FlightData
```

```

where rand() <= 0.1
distribute by rand()
sort by rand()
limit 8000000;

```

```
SELECT COUNT(*) from FlightData2;
```

_c0
7999999

## 7. Data Engineering

### 1. Drop unusable columns

```
ALTER TABLE FlightData2 REPLACE COLUMNS (FlightID string, SearchDate date,
FlightDate date, StartingAirport string,
```

```
DestinationAirport string, FareBasisCode string, TravelDuration string,
```

```
ElapsedDays int, IsBasicEconomy boolean, IsRefundable boolean,
```

```
IsNonStop boolean, BaseFare double, TotalFare double, SeatsRemaining int,
```

```
TotalTravelDistance int, SegmentsAirlineName string, SegmentsEquipmentDescription
string);
```

```
SELECT * FROM FlightData2 LIMIT 2;
```

flightdata2.flightid	flightdata2.searchdate	flightdata2.flighthdate	flightdata2.startingairport	flightdata2.destinationairport	flightdata2.farebasiscode	flightdata2.travelduration	flightdata2.elapseddays	flightdata2.isbasicconomy	flightdata2.isrefundable	flightdata2.isnonstop	flightdata2.basefare	flightdata2.totalfare	flightdata2.segmentsairlinename	flightdata2.segmentsequipmentdescription	flightdata2.seatsremaining	flightdata2.totaltraveledistance	flightdata2.segmentsairlinename	flightdata2.segmentsequipmentdescription
9300a357c8d9b286baa1bdcafc72c77	2022-07-19	false	2022-08-22	SFO	ATL	371.16	1	16611804000	false	true	422.6	LUAHZNN1	PT9H12					
c4bd20e5d7dbffcc32668dcad47ddae2	2022-08-23	193	2022-08-25	DEN	DFW	174.88	0	1661205900	2022-08-22T08:00:00.000-05:00	2022-08-22T17:05:00.000-05:00	GOAIZN81	PT2H5M			650	1661467200	2022-08-25T16:40:00.000-06:00	

2 rows selected (0.335 seconds)

### 2. Remove any duplicate rows from FlightData2 table

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT DISTINCT * FROM FlightData2;
```

```
-- Check number of rows after removing duplicates  
SELECT COUNT(*) from FlightData2;
```

```
+-----+  
| _c0 |  
+-----+  
| 7999958 |  
+-----+  
1 row selected (9.76 seconds)  
+-----+
```

### 3. Check null values

```
SELECT count(*) from FlightData2 where TotalTravelDistance IS NULL;
```

```
+-----+  
| _c0 |  
+-----+  
| 593349 |  
+-----+  
1 row selected (10.083 seconds)  
+-----+
```

```
SELECT count(*) from FlightData2 where FlightDate IS NULL;
```

```
+-----+  
| _c0 |  
+-----+  
| 13 |  
+-----+  
1 row selected (12.509 seconds)  
+-----+
```

```
SELECT count(*) from FlightData2 where StartingAirport IS NULL;
```

```
+-----+  
| _c0 |  
+-----+  
| 5 |  
+-----+  
1 row selected (12.05 seconds)  
+-----+
```

```
SELECT count(*) from FlightData2 where DestinationAirport IS NULL;
```

```
+----+  
| _c0 |  
+----+  
| 11 |  
+----+  
1 row selected (11.734 seconds)
```

```
SELECT count(*) from FlightData2 where TravelDuration IS NULL;
```

```
+----+  
| _c0 |  
+----+  
| 11 |  
+----+  
1 row selected (11.717 seconds)
```

```
SELECT count(*) from FlightData2 where IsBasicEconomy IS NULL;
```

```
+-----+  
| _c0 |  
+-----+  
| 10 |  
+-----+  
1 row selected (11.096 seconds)
```

```
SELECT count(*) from FlightData2 where IsNonStop IS NULL;
```

```
+----+  
| _c0 |  
+----+  
| 11 |  
+----+  
1 row selected (11.459 seconds)
```

```
SELECT count(*) from FlightData2 where BaseFare IS NULL;
```

```
+----+  
| _c0 |  
+----+  
| 11 |  
+----+  
1 row selected (11.587 seconds)
```

```
SELECT count(*) from FlightData2 where TotalFare IS NULL;
```

```
+----+  
| _c0 |  
+----+  
| 11 |  
+----+  
1 row selected (11.584 seconds)
```

```
SELECT count(*) from FlightData2 where SeatsRemaining IS NULL;
```

```
+----+  
| _c0 |  
+----+  
| 11 |  
+----+  
1 row selected (11.57 seconds)
```

```
SELECT count(*) from FlightData2 where SegmentsAirlineName IS NULL;
```

```
+----+  
| _c0 |  
+----+  
| 11 |  
+----+  
1 row selected (11.052 seconds)  
0: jdbc:hive2://biadaiun0.sub0320
```

```
SELECT count(*) from FlightData2 where SegmentsEquipmentDescription IS NULL;
```

```
+-----+
| _c0   |
+-----+
| 11    |
+-----+
1 row selected (10.074 seconds)
0.1s [id:hive2://bigdata0:sub0320]
```

Since our dataset is huge (almost 8 million rows of data), we decided to remove rows with null values detected above.

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE TotalTravelDistance IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE FlightDate IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE StartingAirport IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE DestinationAirport IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE TravelDuration IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE IsBasicEconomy IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE IsNonStop IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2
```

```
SELECT * FROM FlightData2 WHERE BaseFare IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2  
SELECT * FROM FlightData2 WHERE TotalFare IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2  
SELECT * FROM FlightData2 WHERE SeatsRemaining IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2  
SELECT * FROM FlightData2 WHERE SegmentsAirlineName IS NOT NULL;
```

```
INSERT OVERWRITE TABLE FlightData2  
SELECT * FROM FlightData2 WHERE SegmentsEquipmentDescription IS NOT NULL;
```

```
SELECT COUNT(*) from FlightData2;
```

```
+-----+  
| _c0 |  
+-----+  
| 7406035 |  
+-----+  
1 row selected (12.393 seconds)
```

4. Add FlightMonth column by getting the month from FlightDate column

```
ALTER TABLE FlightData2 ADD COLUMNS (FlightMonth int);
```

```
INSERT OVERWRITE TABLE FlightData2  
SELECT FlightID, SearchDate, FlightDate, StartingAirport,  
DestinationAirport, FareBasisCode string, TravelDuration,  
ElapsedDays, IsBasicEconomy, IsRefundable,
```

```
IsNonStop, BaseFare, TotalFare, SeatsRemaining,  
TotalTravelDistance, SegmentsAirlineName , SegmentsEquipmentDescription,  
MONTH(FlightDate) AS FlightMonth FROM FlightData2;
```

```
Select FlightDate, FlightMonth from FlightData2 LIMIT 10;
```

```
+-----+-----+  
| flightdate | flightmonth |  
+-----+-----+  
| 2022-10-16 | 10          |  
| 2022-09-21 | 9           |  
| 2022-10-22 | 10          |  
| 2022-08-02 | 8           |  
| 2022-06-22 | 6           |  
| 2022-10-13 | 10          |  
| 2022-07-29 | 7           |  
| 2022-09-12 | 9           |  
| 2022-07-26 | 7           |  
| 2022-06-10 | 6           |  
+-----+-----+  
10 rows selected (0.423 seconds)
```

5. Add a FlightRoute column that concatenate startingAirport with destinationAirport columns

```
ALTER TABLE FlightData2 ADD COLUMNS (FlightRoute string);
```

```
INSERT OVERWRITE TABLE FlightData2  
SELECT FlightID, SearchDate, FlightDate, StartingAirport,  
DestinationAirport, FareBasisCode string, TravelDuration,  
ElapsedDays, IsBasicEconomy, IsRefundable,  
IsNonStop, BaseFare, TotalFare, SeatsRemaining,  
TotalTravelDistance, SegmentsAirlineName , SegmentsEquipmentDescription, FlightMonth,  
CONCAT(StartingAirport, '-', DestinationAirport) AS FlightRoute  
FROM FlightData2;
```

```
| Select StartingAirport, DestinationAirport, FlightRoute From FlightData2 limit 10;
```

startingairport	destinationairport	flightroute
DTW	LGA	DTW-LGA
DTW	MIA	DTW-MIA
LGA	LAX	LGA-LAX
SFO	BOS	SFO-BOS
ATL	EWR	ATL-EWR
OAK	JFK	OAK-JFK
PHL	LGA	PHL-LGA
LAX	ORD	LAX-ORD
DTW	LAX	DTW-LAX
LGA	IAD	LGA-IAD

```
10 rows selected (0.426 seconds)
```

**8. Write analysis queries, export result to HDFS, secure copy text files to local computer, and create visualizations**

1. Top 10 most popular flight routes

```
INSERT OVERWRITE DIRECTORY '/user/amach3/FlightData2/FlightRoute/'  
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','  
SELECT FlightRoute, COUNT(FlightID) AS FlightCount  
FROM FlightData2  
GROUP BY FlightRoute  
ORDER BY FlightCount DESC  
3.LIMIT 10;
```

```

+-----+-----+
| flightroute | flightcount |
+-----+-----+
| LAX-BOS    | 63138   |
| LAX-JFK    | 60804   |
| BOS-LAX    | 60343   |
| LAX-LGA    | 60184   |
| LGA-LAX    | 59909   |
| JFK-LAX    | 58965   |
| LAX-ATL    | 55249   |
| JFK-ORD    | 54146   |
| ATL-LAX    | 53787   |
| CLT-LAX    | 53472   |
+-----+
10 rows selected (10.983 seconds)

```

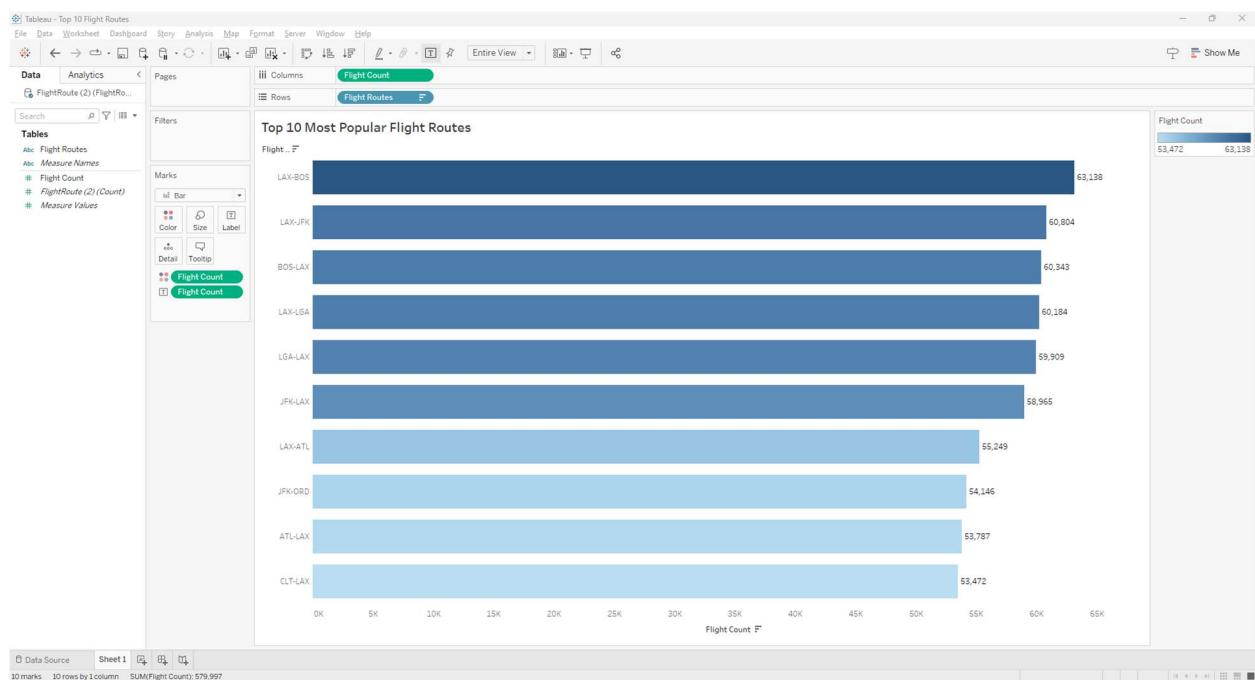
hdfs dfs -get /user/amach3/FlightData2/FlightRoute/000000\_0 FlightRoute.txt

[scp amach3@144.24.53.159:/home/amach3/FlightRoute.txt FlightRoute.txt](#)

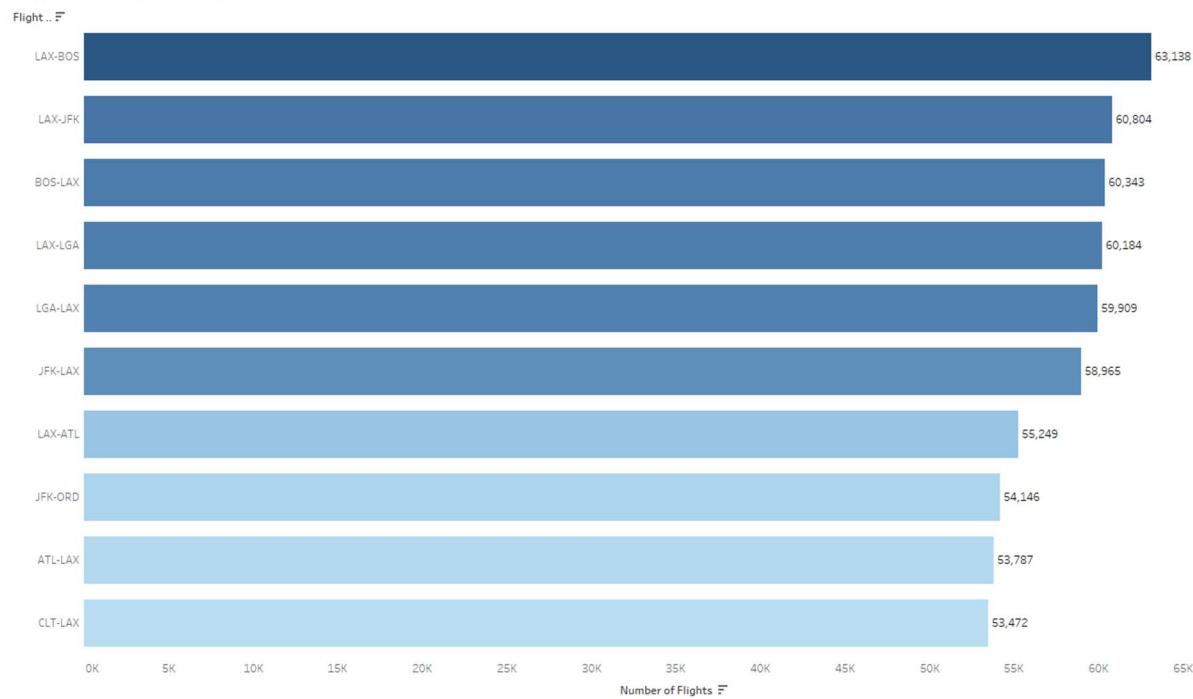
```

jiazh@LAPTOP-2FFALVQG MINGW64 ~
$ scp amach3@144.24.53.159:/home/amach3/FlightRoute.txt FlightRoute.txt
amach3@144.24.53.159's password:
FlightRoute.txt                                100%  140      3.3KB/s  00:00

```



#### Top 10 Most Popular Flight Routes



#### 2. Least 10 popular flight routes

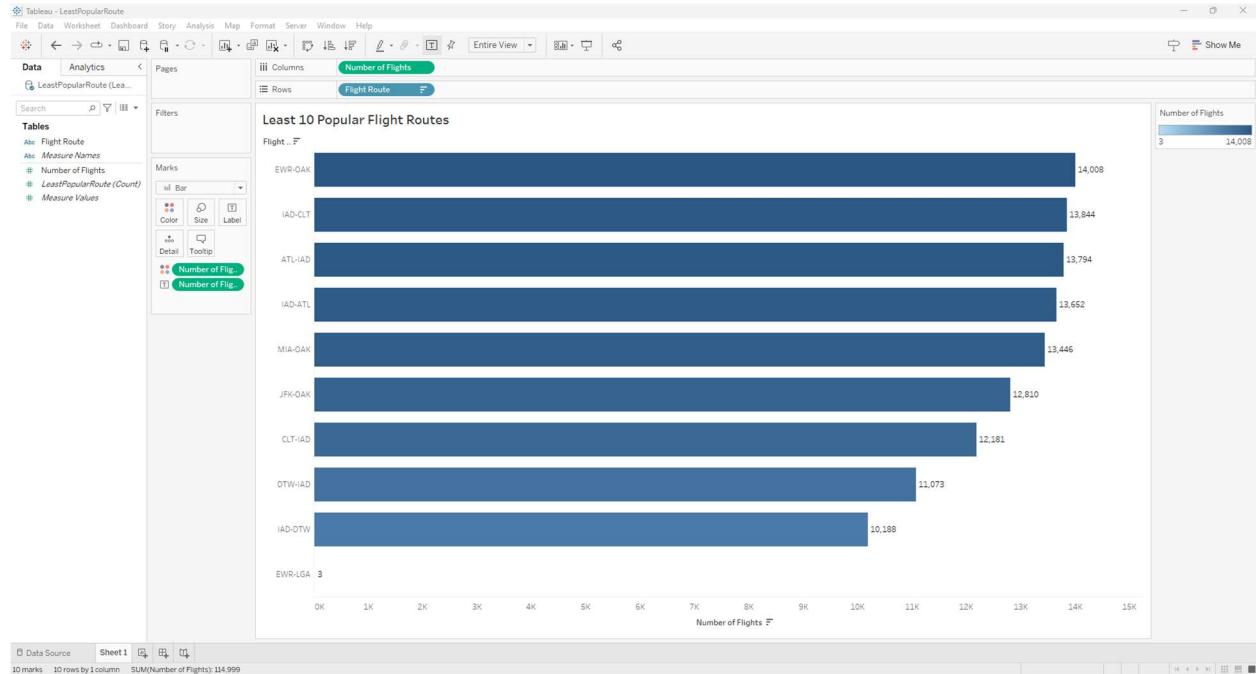
```
INSERT OVERWRITE DIRECTORY '/user/amach3/FlightData2/LeastPopularRoute/'  
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','  
SELECT FlightRoute, COUNT(FlightID) AS FlightCount  
FROM FlightData2  
GROUP BY FlightRoute  
ORDER BY FlightCount ASC  
LIMIT 10;
```

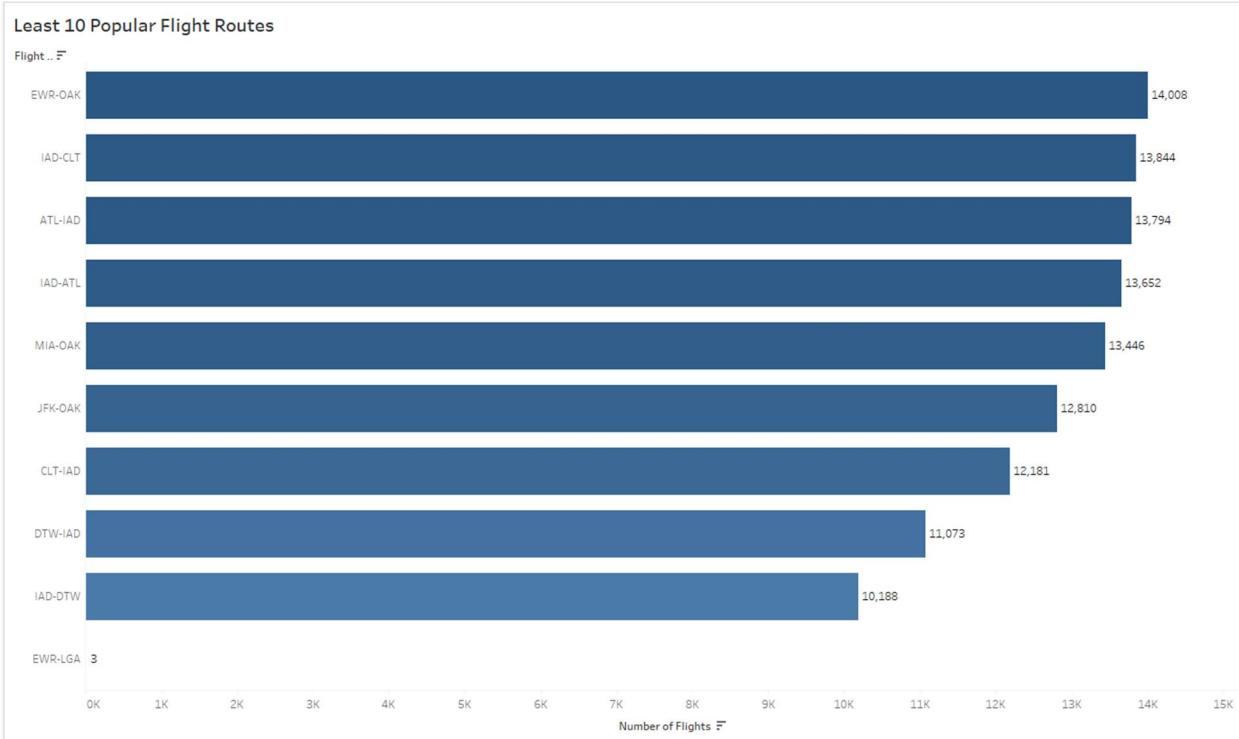
flightroute	flightcount
EWR-LGA	3
IAD-DTW	10188
DTW-IAD	11073
CLT-IAD	12181
JFK-OAK	12810
MIA-OAK	13446
IAD-ATL	13652
ATL-IAD	13794
IAD-CLT	13844
EWR-OAK	14008

```
hdfs dfs -get /user/amach3/FlightData2/LeastPopularRoute/000000_0 LeastPopularRoute.txt
```

```
scp amach3@144.24.53.159:/home/amach3/LeastPopularRoute.txt LeastPopularRoute.txt
```

```
jiazh@LAPTOP-ZFFALVOG MINGW64 ~
$ scp amach3@144.24.53.159:/home/amach3/LeastPopularRoute.txt LeastPopularRoute.txt
amach3@144.24.53.159's password:
LeastPopularRoute.txt                                         100%   136      2.7KB/s  00:00
```



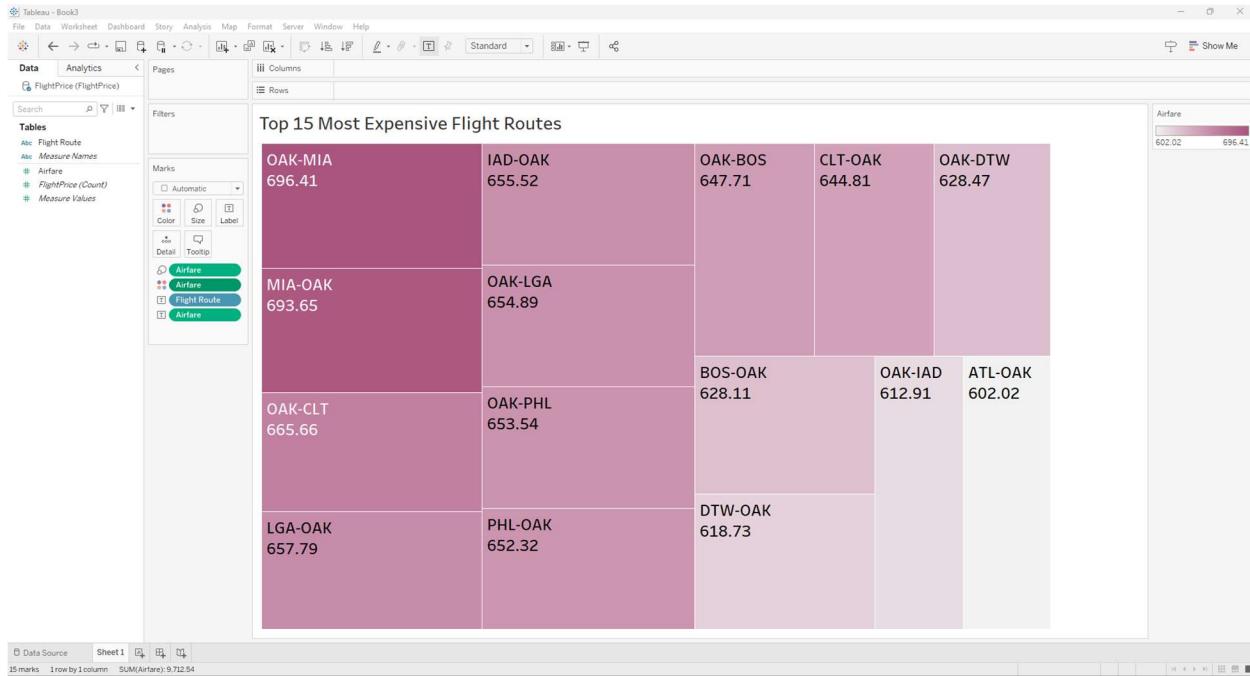


### 3. Top 15 most expensive routes

```
INSERT OVERWRITE DIRECTORY '/user/amach3/FlightData2/FlightPrice/'
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
SELECT FlightRoute, ROUND(AVG(TotalFare),2) AS FlightPrice
FROM FlightData2
GROUP BY FlightRoute
ORDER BY FlightPrice DESC LIMIT 15;
```

flightroute	flightprice
OAK-MIA	696.41
MIA-OAK	693.65
OAK-CLT	665.66
LGA-OAK	657.79
IAD-OAK	655.52
OAK-LGA	654.89
OAK-PHL	653.54
PHL-OAK	652.32
OAK-BOS	647.71
CLT-OAK	644.81
OAK-DTW	628.47
BOS-OAK	628.11
DTW-OAK	618.73
OAK-IAD	612.91
ATL-OAK	602.02

```
hdfs dfs -get /user/amach3/FlightData2/FlightPrice/000000_0 FlightPrice.txt  
scp amach3@144.24.53.159:/home/amach3/FlightPrice.txt FlightPrice.txt
```



Top 15 Most Expensive Flight Routes

OAK-MIA 696.41	IAD-OAK 655.52	OAK-BOS 647.71	CLT-OAK 644.81	OAK-DTW 628.47
MIA-OAK 693.65	OAK-LGA 654.89			
OAK-CLT 665.66	OAK-PHL 653.54	BOS-OAK 628.11	OAK-IAD 612.91	ATL-OAK 602.02
LGA-OAK 657.79	PHL-OAK 652.32	DTW-OAK 618.73		

### 3. Airfare and Travel Distance over time

INSERT OVERWRITE DIRECTORY  
 '/user/amach3/FlightData2/PriceDistanceOverTime/'

```
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','  
SELECT FlightMonth, ROUND(AVG(TotalFare),2) AS AverageAirfare,  
ROUND(AVG(TotalTravelDistance),2) AS AverageTravelDistance  
FROM FlightData2  
GROUP BY FlightMonth;
```

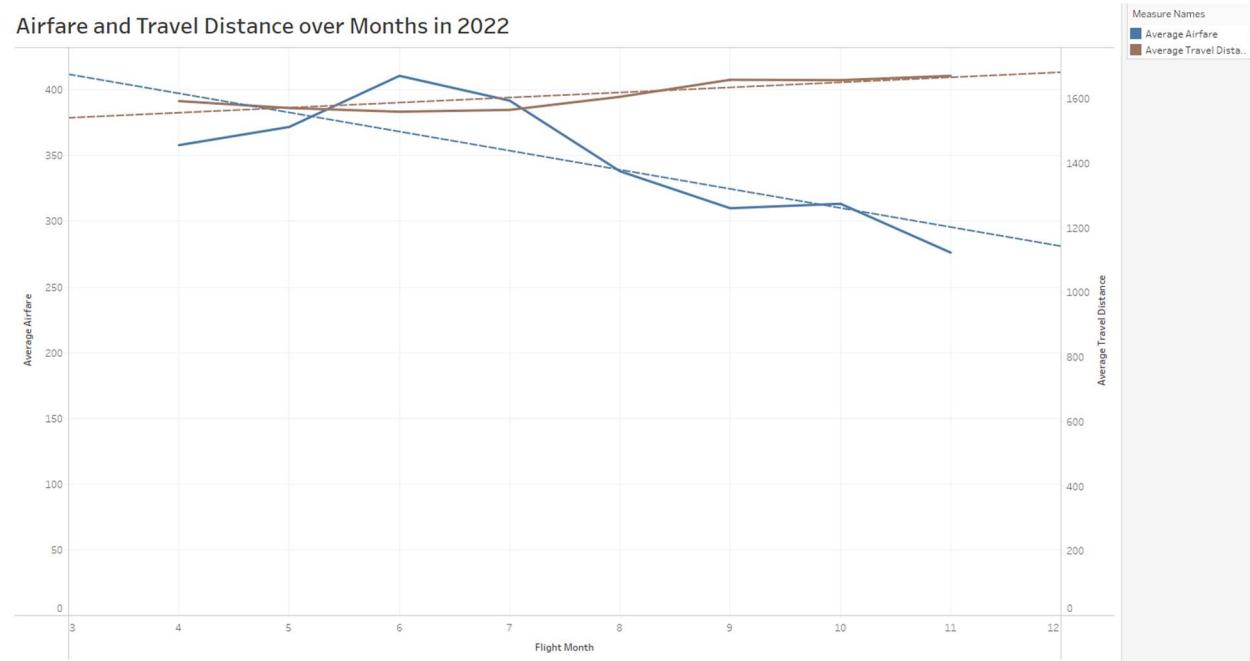
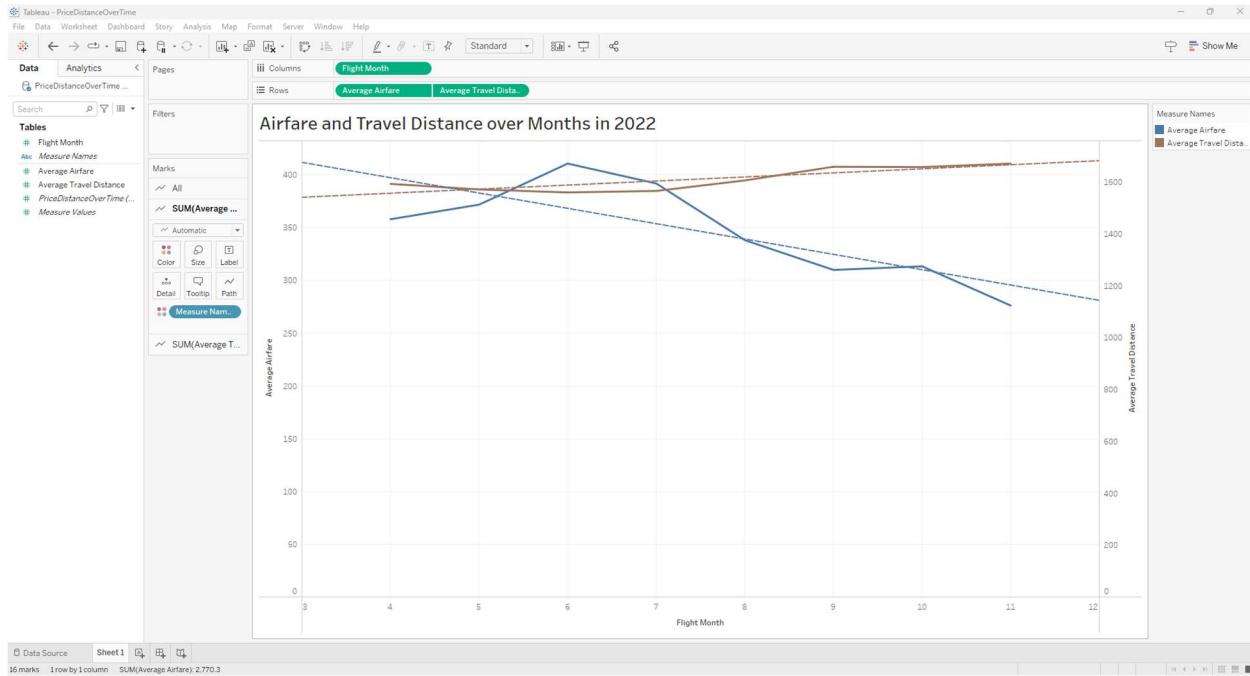
flightmonth	averageairfare	averagetraveldistance
8	338.14	1606.34
4	358.01	1593.09
6	410.76	1560.08
7	391.91	1565.84
10	313.39	1657.82
11	276.23	1671.29
5	371.85	1571.6
9	309.98	1659.03

8 rows selected (13.431 seconds)

```
hdfs dfs -get /user/amach3/FlightData2/PriceDistanceOverTime/000000_0  
PriceDistanceOverTime.txt
```

```
scp amach3@144.24.53.159:/home/amach3/PriceDistanceOverTime.txt  
PriceDistanceOverTime.txt
```

```
jiazh@LAPTOP-2FFALVQG MINGW64 ~  
$ scp amach3@144.24.53.159:/home/amach3/PriceDistanceOverTime.txt PriceDistanceOve  
rTime.txt  
amach3@144.24.53.159's password:  
PriceDistanceOverTime.txt 100% 17 0.3KB/s 00:00
```



- Which are the most popular destinations over the months?

```

INSERT OVERWRITE DIRECTORY '/user/amach3/FlightData2/Destination/'
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
SELECT DestinationAirport, date_format(FlightDate,'MM-01-yyyy') AS
formatted_date, Latitude, Longitude, COUNT(FlightID) AS FlightCount
FROM FlightData2 F
JOIN Airport A
  
```

ON F.DestinationAirport = A.IATA  
 GROUP BY DestinationAirport,date\_format(FlightDate,'MM-01-yyyy'), Latitude,  
 Longitude;

destinationairport	formatted_date	latitude	longitude	flightcount
ATL	07-01-2022	33.6367	-84.428101	71991
ATL	09-01-2022	33.6367	-84.428101	95253
BOS	05-01-2022	42.36429977	-71.00520325	47187
BOS	11-01-2022	42.36429977	-71.00520325	17078
DEN	10-01-2022	39.86169815	-104.6729965	53910
DFW	06-01-2022	32.896801	-97.038002	67548
DFW	11-01-2022	32.896801	-97.038002	15644
DTW	10-01-2022	42.21239853	-83.35340118	49283
EWR	10-01-2022	40.69250107	-74.16870117	45257
JFK	11-01-2022	40.63980103	-73.77890015	13539
ORD	09-01-2022	41.9786	-87.9048	110728
PHL	07-01-2022	39.87189865	-75.2410965	66857
DEN	09-01-2022	39.86169815	-104.6729965	88198
DTW	07-01-2022	42.21239853	-83.35340118	62527
DTW	08-01-2022	42.21239853	-83.35340118	78988
IAD	06-01-2022	38.94449997	-77.45580292	50838
LAX	06-01-2022	33.94250107	-118.4079971	99473
LAX	09-01-2022	33.94250107	-118.4079971	145866
LGA	10-01-2022	40.77719879	-73.87259674	72834
OAK	06-01-2022	37.721298	-122.221001	37366
ORD	07-01-2022	41.9786	-87.9048	80350
SFO	06-01-2022	37.61899948	-122.375	76918
DEN	05-01-2022	39.86169815	-104.6729965	40034
DFW	08-01-2022	32.896801	-97.038002	112516
DTW	09-01-2022	42.21239853	-83.35340118	82245
LGA	07-01-2022	40.77719879	-73.87259674	96853
OAK	04-01-2022	37.721298	-122.221001	2882
OAK	11-01-2022	37.721298	-122.221001	11642
PHL	08-01-2022	39.87189865	-75.2410965	91432
PHL	11-01-2022	39.87189865	-75.2410965	12593
SFO	10-01-2022	37.61899948	-122.375	70440
ATL	08-01-2022	33.6367	-84.428101	93638
BOS	06-01-2022	42.36429977	-71.00520325	76186
DEN	11-01-2022	39.86169815	-104.6729965	12728
ORD	08-01-2022	41.9786	-87.9048	109741
ATL	10-01-2022	33.6367	-84.428101	60705
BOS	08-01-2022	42.36429977	-71.00520325	116800
BOS	09-01-2022	42.36429977	-71.00520325	114389
BOS	10-01-2022	42.36429977	-71.00520325	75810
CLT	07-01-2022	35.2140007	-80.94309998	75434
CLT	10-01-2022	35.2140007	-80.94309998	72829
CLT	11-01-2022	35.2140007	-80.94309998	15711
DEN	08-01-2022	39.86169815	-104.6729965	94902
DFW	07-01-2022	32.896801	-97.038002	77572
DFW	10-01-2022	32.896801	-97.038002	72630
DTW	11-01-2022	42.21239853	-83.35340118	11516
IAD	04-01-2022	38.94449997	-77.45580292	3518
JFK	08-01-2022	40.63980103	-73.77890015	93881
JFK	10-01-2022	40.63980103	-73.77890015	59116
LAX	04-01-2022	33.94250107	-118.4079971	8211
LAX	05-01-2022	33.94250107	-118.4079971	61966
MIA	04-01-2022	25.79319954	-80.29060364	6634
MIA	07-01-2022	25.79319954	-80.29060364	73082
OAK	10-01-2022	37.721298	-122.221001	47293
CLT	05-01-2022	35.2140007	-80.94309998	47144
CLT	09-01-2022	35.2140007	-80.94309998	109579
DEN	07-01-2022	39.86169815	-104.6729965	70902
DFW	05-01-2022	32.896801	-97.038002	44603
JFK	04-01-2022	40.63980103	-73.77890015	4335
LAX	10-01-2022	33.94250107	-118.4079971	90062
LAX	11-01-2022	33.94250107	-118.4079971	20264
LGA	04-01-2022	40.77719879	-73.87259674	6452
MIA	06-01-2022	25.79319954	-80.29060364	68290
MIA	11-01-2022	25.79319954	-80.29060364	13816
ORD	04-01-2022	41.9786	-87.9048	5759
ORD	05-01-2022	41.9786	-87.9048	45344
SFO	05-01-2022	37.61899948	-122.375	48895
SFO	09-01-2022	37.61899948	-122.375	112273
ATL	05-01-2022	33.6367	-84.428101	44436
ATL	06-01-2022	33.6367	-84.428101	65124
EWR	06-01-2022	40.69250107	-74.16870117	54056
EWR	08-01-2022	40.69250107	-74.16870117	73737
EWR	09-01-2022	40.69250107	-74.16870117	70677
IAD	05-01-2022	38.94449997	-77.45580292	28576
IAD	07-01-2022	38.94449997	-77.45580292	55505

origin	origin_date	latitude	longitude	flightcount
IAD	07-01-2022	38.94449997	-77.45580292	55505
LAX	07-01-2022	33.94250107	-118.4079971	114778
MIA	09-01-2022	25.79319954	-80.29060364	95679
PHL	04-01-2022	39.87189865	-75.2410965	4156
SFO	07-01-2022	37.61899948	-122.375	87888
SFO	08-01-2022	37.61899948	-122.375	116333
CLT	08-01-2022	35.2140007	-80.94309998	104851
DEN	06-01-2022	39.86169815	-104.6729965	61438
DTW	05-01-2022	42.21239853	-83.35340118	34351
MIA	05-01-2022	25.79319954	-80.29060364	47015
MIA	08-01-2022	25.79319954	-80.29060364	93514
OAK	07-01-2022	37.721298	-122.221001	43490
ORD	10-01-2022	41.9786	-87.9048	69216
ORD	11-01-2022	41.9786	-87.9048	15720
PHL	06-01-2022	39.87189865	-75.2410965	60302
CLT	04-01-2022	35.2140007	-80.94309998	5563
EWR	05-01-2022	40.69250107	-74.16870117	34299
IAD	10-01-2022	38.94449997	-77.45580292	41800
JFK	06-01-2022	40.63980103	-73.77890015	57334
MIA	10-01-2022	25.79319954	-80.29060364	60762
OAK	05-01-2022	37.721298	-122.221001	22825
PHL	05-01-2022	39.87189865	-75.2410965	38376
BOS	04-01-2022	42.36429977	-71.00520325	5113
CLT	06-01-2022	35.2140007	-80.94309998	69230
DEN	04-01-2022	39.86169815	-104.6729965	5843
DFW	09-01-2022	32.896801	-97.038002	114076

destinationairport	formatted_date	latitude	longitude	flightcount
DTW	04-01-2022	42.21239853	-83.35340118	4610
EWR	04-01-2022	40.69250107	-74.16870117	4143
EWR	11-01-2022	40.69250107	-74.16870117	10482
IAD	08-01-2022	38.94449997	-77.45580292	66424
IAD	09-01-2022	38.94449997	-77.45580292	61443
LAX	08-01-2022	33.94250107	-118.4079971	154699
LGA	05-01-2022	40.77719879	-73.87259674	53223
LGA	09-01-2022	40.77719879	-73.87259674	117876
ORD	06-01-2022	41.9786	-87.9048	68904
PHL	09-01-2022	39.87189865	-75.2410965	92493
SFO	11-01-2022	37.61899948	-122.375	16120
ATL	04-01-2022	33.6367	-84.428101	5584
ATL	11-01-2022	33.6367	-84.428101	13183
EWR	07-01-2022	40.69250107	-74.16870117	58883
JFK	05-01-2022	40.63980103	-73.77890015	36718
JFK	09-01-2022	40.63980103	-73.77890015	91169
LGA	08-01-2022	40.77719879	-73.87259674	123334
LGA	11-01-2022	40.77719879	-73.87259674	15952
OAK	09-01-2022	37.721298	-122.221001	76588
SFO	04-01-2022	37.61899948	-122.375	5931
BOS	07-01-2022	42.36429977	-71.00520325	89571
DFW	04-01-2022	32.896801	-97.038002	6283
DTW	06-01-2022	42.21239853	-83.35340118	54456
IAD	11-01-2022	38.94449997	-77.45580292	9780
JFK	07-01-2022	40.63980103	-73.77890015	68896
LGA	06-01-2022	40.77719879	-73.87259674	83205
OAK	08-01-2022	37.721298	-122.221001	69076
PHL	10-01-2022	39.87189865	-75.2410965	60666

128 rows selected (42.332 seconds)

```
hdfs dfs -get /user/amach3/FlightData2/Destination/000000_0
hdfs dfs -get /user/amach3/FlightData2/Destination/000001_0
hdfs dfs -get /user/amach3/FlightData2/Destination/000002_0
hdfs dfs -get /user/amach3/FlightData2/Destination/000003_0
hdfs dfs -get /user/amach3/FlightData2/Destination/000004_0
hdfs dfs -get /user/amach3/FlightData2/Destination/000005_0
```

```
hdfs dfs -get /user/amach3/FlightData2/Destination/000006_0  
hdfs dfs -get /user/amach3/FlightData2/Destination/000007_0  
hdfs dfs -get /user/amach3/FlightData2/Destination/000008_0  
hdfs dfs -get /user/amach3/FlightData2/Destination/000009_0  
hdfs dfs -get /user/amach3/FlightData2/Destination/000010_0  
hdfs dfs -get /user/amach3/FlightData2/Destination/000011_0
```

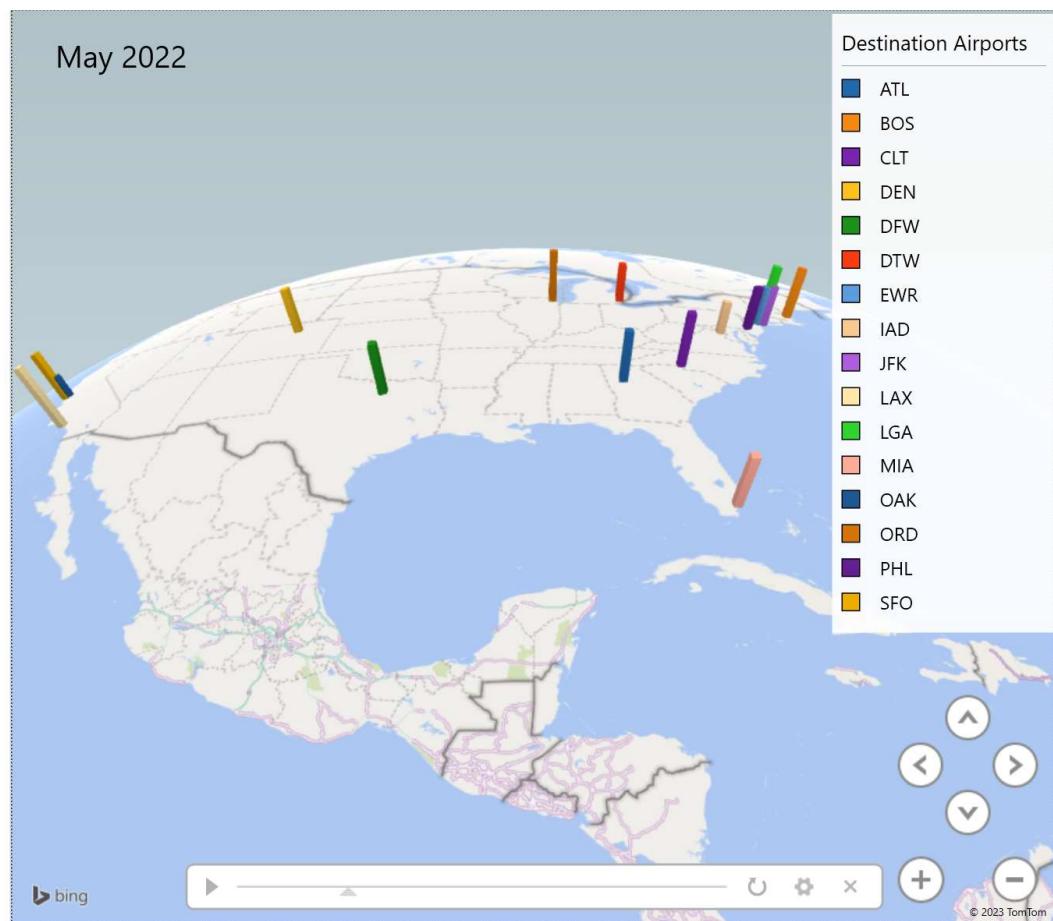
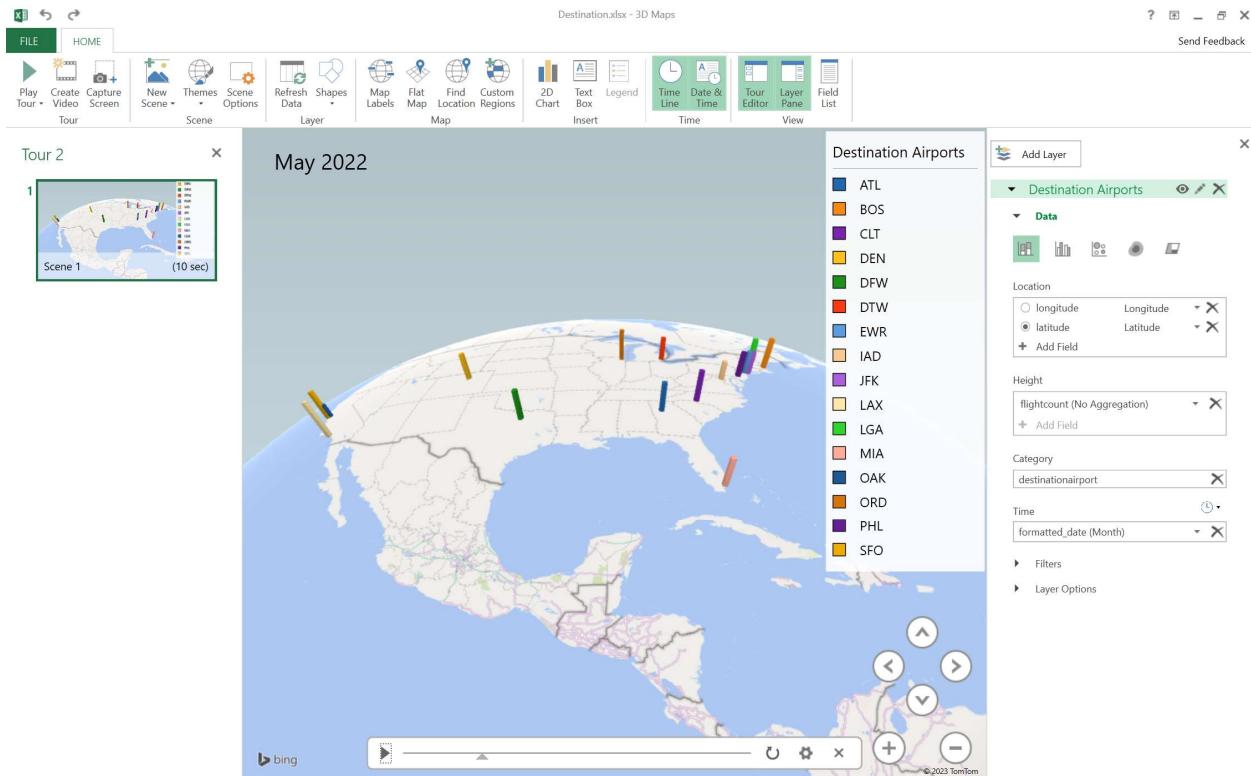
```
ls - /user/amach3/FlightData2/Destination : No such type of directory  
-bash-4.2$ hdfs dfs -ls /user/amach3/FlightData2/Destination  
Found 12 items  
-rw-r--r-- 3 amach3 hdfs 524 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000000_0  
-rw-r--r-- 3 amach3 hdfs 446 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000001_0  
-rw-r--r-- 3 amach3 hdfs 398 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000002_0  
-rw-r--r-- 3 amach3 hdfs 171 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000003_0  
-rw-r--r-- 3 amach3 hdfs 853 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000004_0  
-rw-r--r-- 3 amach3 hdfs 613 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000005_0  
-rw-r--r-- 3 amach3 hdfs 532 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000006_0  
-rw-r--r-- 3 amach3 hdfs 394 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000007_0  
-rw-r--r-- 3 amach3 hdfs 316 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000008_0  
-rw-r--r-- 3 amach3 hdfs 671 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000009_0  
-rw-r--r-- 3 amach3 hdfs 394 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000010_0  
-rw-r--r-- 3 amach3 hdfs 358 2023-05-05 03:16 /user/amach3/FlightData2/Destination/000011_0  
-bash-4.2$
```

```
cat 000000_0 000002_0 000003_0 000001_0 000004_0 000005_0 000006_0 000007_0  
000008_0 000009_0 000010_0 000011_0 > Destination.txt
```

```
-bash-4.2$ ls  
000000_0 000002_0 000004_0 000006_0 000008_0 000010_0 Destination.txt  
000001_0 000003_0 000005_0 000007_0 000009_0 000011_0  
-bash-4.2$
```

```
scp amach3@144.24.53.159:/home/amach3/Destination.txt Destination.txt
```

```
jiazh@LAPTOP-2FFALVQG MINGW64 ~  
$ scp amach3@144.24.53.159:/home/amach3/Destination.txt  
Destination.txt  
amach3@144.24.53.159's password:  
Destination.txt 100% 5670 114.2KB/s 00:00
```



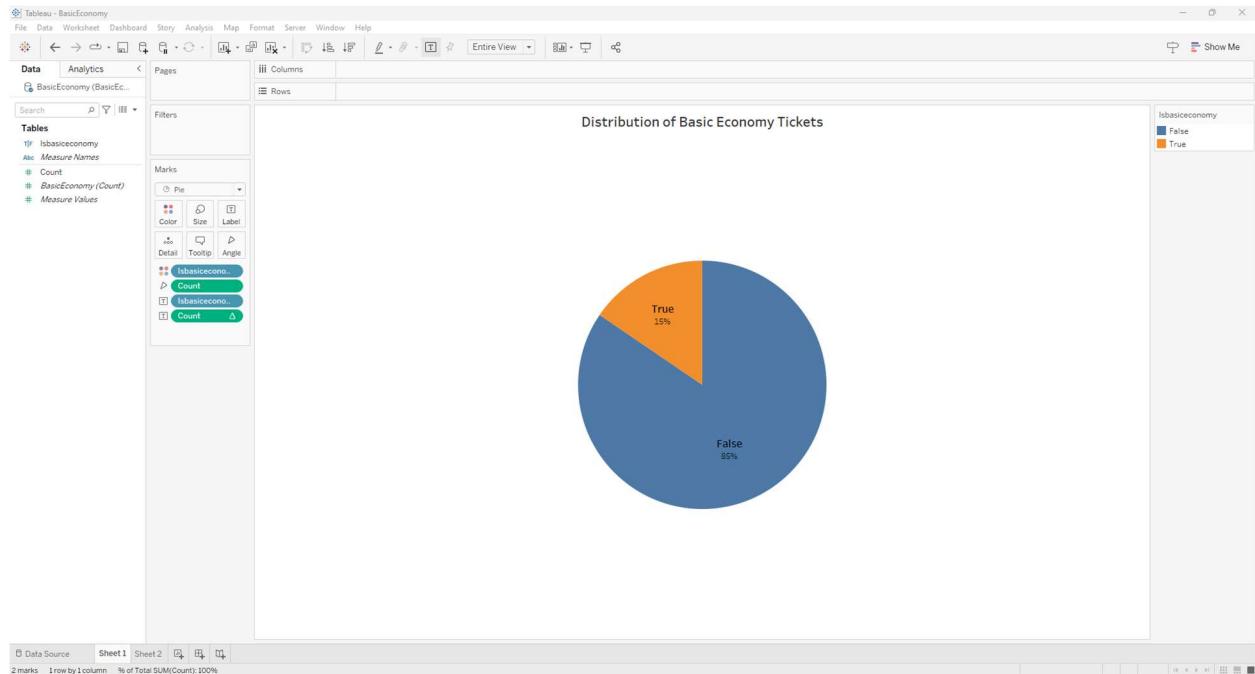
## 5. Distribution of basic economy tickets

```
INSERT OVERWRITE DIRECTORY '/user/amach3/FlightData2/BasicEconomy/'
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
SELECT isBasicEconomy, COUNT(*) as count
FROM FlightData2
GROUP BY isBasicEconomy;
```

```
+-----+-----+
| isbasicconomy | count   |
+-----+-----+
| true          | 1146599 |
| false         | 6259805 |
+-----+-----+
2 rows selected (12.57 seconds)
```

```
hdfs dfs -get /user/amach3/FlightData2/BasicEconomy/000000_0 BasicEconomy.txt
scp amach3@144.24.53.159:/home/amach3/BasicEconomy.txt BasicEconomy.txt
```

```
jiazh@LAPTOP-2FFALVQG MINGW64 ~
$ scp amach3@144.24.53.159:/home/amach3/BasicEconomy.txt BasicEconomy.txt
amach3@144.24.53.159's password:
BasicEconomy.txt                                100%   13      0.3KB/s  00:00
```



Distribution of Basic Economy Tickets

