



# CIS5200 Term Project Tutorial



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## Cargurus Used Cars Data Analysis Using Hadoop

### Term Project(Group 2)

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### Objectives

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

- Download data from amazon S3 and upload the data to the Hadoop cluster
- Create Hive tables in HDFS using HiveQL.
- Create HiveQL queries to manipulate and analyze the data
- Visualize the result in Excel, Tableau, and Power BI.

## Introduction

Due to the increased cost of new cars and the consumer's desire to save income, used car sales are on a worldwide increase. The dataset used in this project is from the Kaggle website. It contains the most relevant information that CarGurus provides for used cars. Analysis of this data can help to infer the inventory of used cars based on make and model, price, transmission, mileage, city, body types, and each region-wise, etc.

## Platform Spec

- Cluster Version – Oracle Big Data Compute Edition
- Number of Nodes – 3
- Memory size – 180 GB
- CPU – 12 OCPUs
- Storage – 957 GB

## Prerequisites

Everything you need to go through the scripts and queries is already provisioned with the cluster. To export the analyzed data to Microsoft Excel, you must meet the following requirements:

- You must have a username and ipaddress to connect to an Oracle Cloud account.
- You must have **Microsoft Excel 2010, 2013 or 2016** installed.
- You must have Tableau and Power BI installed on your machine for visualizations.
- You must have an account with the Power BI.

# 1. Connect to Oracle Cloud: Big Data Compute

You need to remotely access your Oracle Big Data that you executed in your Oracle Cloud account using ssh. Your CalStateLA username(**syadav5**) should be a username/password to connect to the Hadoop cluster at BDCE as follows:

**NOTE:** Do not forget to change **syadav5** with your username.

```
$ ssh syadav5@129.150.69.91
```

To enter password, type in your user name and press enter.

```
msavi@LAPTOP-306GU84C MINGW64 ~
$ ssh syadav5@129.150.69.91
-- WARNING -- This system is for the use of authorized users only. Individuals
using this computer system without authority or in excess of their authority
are subject to having all their activities on this system monitored and
recorded by system personnel. Anyone using this system expressly consents to
such monitoring and is advised that if such monitoring reveals possible
evidence of criminal activity system personnel may provide the evidence of such
monitoring to law enforcement officials.

syadav5@129.150.69.91's password:
Last login: Thu Nov 12 07:47:26 2020 from 24.6.79.203
-bash-4.1$ |
```

You are successfully connected to Oracle cloud.

## 2. Used Car data Loaded into Oracle Big Data

Loading the project datasets in your local directory will end up crashing due to space constraints. Try to load the data in any of the available directories.

For instance, point out the current location to **the “/dev/shm”** directory

**Note:** Make sure to delete the files from the **/dev/shm** home directory once you are done uploading the file in the **HDFS** directory.

Use the following command to change the directory.

```
$ cd dev/shm/
```

Below is the location of the CarGurus usedcar data that is used for this project. You can download the data file from amazon S3 as follows:

```
$ wget -O CarData.zip http://usedcardataset.s3.amazonaws.com/archive.zip
```

You should get something like this:

```
-bash-4.1$ wget -O CarData.zip http://usedcardataset.s3.amazonaws.com/archive.zip
--2020-11-12 00:15:18-- http://usedcardataset.s3.amazonaws.com/archive.zip
Resolving usedcardataset.s3.amazonaws.com... 52.216.104.59
Connecting to usedcardataset.s3.amazonaws.com|52.216.104.59|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2287140843 (2.1G) [application/zip]
Saving to: "CarData.zip"

100%[=====>] 2,287,140,843 33.0M/s  in 89s

2020-11-12 00:16:48 (24.5 MB/s) - "CarData.zip" saved [2287140843/2287140843]

-bash-4.1$
```

Then, you need to unzip the files.

```
$ unzip CarData.zip
```

List current directory to check if all the files are available in your home directory:

```
-bash-4.1$ ls
CarData.zip  used_cars_data.csv
-bash-4.1$
```

### 3. Create directories in HDFS

Run the following commands for creating directories:

```
$ hdfs dfs -mkdir GP2TermProject
$ hdfs dfs -mkdir GP2TermProject/tables
$ hdfs dfs -mkdir GP2TermProject/tables/cgdata
```

To view the files and directories created at HDFS use the following command:

```
$ hdfs dfs -ls GP2TermProject/tables
```

```
-bash-4.1$
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables
Found 1 items
drwxr-xr-x  - syadav5 hdfs      0 2020-11-12 22:00 GP2TermProject/tables/cgdata
-bash-4.1$
```

### 4. Put files in HDFS directories

Run the following commands to put dictionaries into respective folders:

```
$ hdfs dfs -put /dev/shm/used_cars_data.csv GP2TermProject/tables/cgdata/
```

You can run the following commands to check the files are there:

```
$ hdfs dfs -ls GP2TermProject/tables/cgdata/
```

```
-bash-4.1$
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/cgdata/
Found 1 items
-rw-r--r--  2 syadav5 hdfs 9980208148 2020-11-12 22:06 GP2TermProject/tables/cgdata/used_cars_data.csv
-bash-4.1$ |
```

Run the following HDFS command to provide permission to the files under the project folder.

**NOTE:** To make your beeline command work properly, use the following command.

```
$ hdfs dfs -chmod -R o+w GP2TermProject/
```

## 5. Creating Hive tables to query data

The following Hive statement creates an external table that allows Hive to query data stored in HDFS. External tables preserve the data in the original file format while allowing the Hive to perform queries against the data within the file.

The Hive statements below creates a new table named `cargurus_usedcars`, by describing the fields within the file, the delimiter (Comma) between fields.

Now open another terminal window and login into your account using `ssh` command.

Open **beeline** Command Line Interface using the following command to run hive queries.

**Beeline** is for multiple user's access to Hive Server 2 of a Hadoop cluster. You have to copy and paste the "**!connect ...**" command given by the instructor at beeline and press enter without any password when it asks for a password.

```
$ beeline
```

```
-bash-4.1$ beeline
```

```
WARNING: Use "yarn jar" to launch YARN applications.
```

```
Beeline version 1.2.1000.2.4.2.0-258 by Apache Hive
```

```
beeline>
```

**NOTE:** Type the **connect** command as follows, and it should be given by the instructor:

```
beeline> !connect
```

```
jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigdai-nov-bdcsce-2:2181,bigdai-nov-bdcsce-3:2181/;serviceDiscoveryMode=zooKeeper;zooKeeperNamespace=hiveserver2?tez.queue.name=interactive
bdcsce_admin
```

```
Connecting to
```

```
jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigdai-nov-bdcsce-2:2181,bigdai-nov-bdcsce-3:2181/;serviceDiscoveryMode=zooKeeper;zooKeeperNamespace=hiveserver2?tez.queue.name=interactive
```

```
Enter password for
```

```
jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigdai-nov-bdcsce-2:2181,bigdai-nov-bdcsce-3:2181/;serviceDiscoveryMode=zooKeeper;zooKeeperNamespace=hiveserver2?tez.queue.name=interactive:
```

```
Connected to: Apache Hive (version 1.2.1000.2.4.2.0-258)
```

```
Driver: Hive JDBC (version 1.2.1000.2.4.2.0-258)
```

Transaction isolation: TRANSACTION\_REPEATABLE\_READ

0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd>

**NOTE:** If you see “**CLOSED**” in the above beeline shell prompt, it is not connected to Hive Server2.

Now you have to create your database with your username to separate your tables with other users. For example, the user **syadav5** should run the following:

**NOTE:** You have to use your username.

0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> create database if not exists syadav5;

No rows affected (0.188 seconds)

0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> show databases;

```
+-----+--+
| database_name |
+-----+--+
| default      |
| jwoo5        |
| kyayosh      |
| malam       |
| mcampo61     |
| pramdass2    |
| syadav5      |
+-----+--+
```

7 rows selected (0.167 seconds)

0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> use syadav5;

No rows affected (0.17 seconds)

In the beeline shell CLI, you need to copy and paste the following HiveQL code to create an external table "cargurus\_usedcars".

**NOTE:** Don't forget to replace **syadav5** to your account name in the following HQL code.

```
DROP TABLE IF EXISTS cargurus_usedcars;
```

```
CREATE EXTERNAL TABLE IF NOT EXISTS cargurus_usedcars(vin string, back_legroom string, bed string,
bed_height string, bed_length string, body_type string, cabin string, city string, city_fuel_economy
float, combine_fuel_economy int, daysonmarket int, dealer_zip string, description string,
engine_cylinders string, engine_displacement float, engine_type string, exterior_color string, fleet
string, frame_damaged string, franchise_dealer string, franchise_make string, front_legroom string,
fuel_tank_volume string, fuel_type string, has_accidents string, height string, highway_fuel_economy
float, horsepower int, interior_color string, iscab string, is_certified string, is_cpo string, is_new
boolean, is_oemcpo string, latitude double, length string, listed_date date, listing_color string,
listing_id bigint, longitude double, main_picture_url string, major_options string, make_name string,
maximum_seating string, mileage float, model_name string, owner_count int, power string, price float,
salvage string, savings_amount int, seller_rating float, sp_id bigint, sp_name string, theft_title string,
torque string, transmission string, transmission_display string, trimid string, trim_name string,
vehicle_damage_category string, wheel_system string, wheel_system_display string, wheelbase
string, width string, year int) ROW FORMAT SERDE 'org.apache.hadoop.hive.serde2.OpenCSVSerde'
WITH SERDEPROPERTIES ("separatorChar" = ",", "quoteChar" = "\"") STORED AS TEXTFILE LOCATION
'/user/syadav5/GP2TermProject/tables/cgdata/' TBLPROPERTIES ('skip.header.line.count' = '1');
```

Then, in the beeline shell, you need to check if the table “cargurus\_usedcars” is shown:

```
show tables;
```

```
0: jdbc:hive2://bigdai-nov-bdcscs-1:2181,bigd> show tables;
```

```
+-----+--+
|  tab_name  |
+-----+--+
| cargurus_usedcars |
+-----+--+
1 row selected (0.173 seconds)
```



Next you can query the content of the cargurus\_usedcars table:

```
select vin, body_type, city, latitude, longitude, make_name, maximum_seating, mileage, model_name, price, seller_rating, transmission, trim_name, year from cargurus_usedcars limit 20;
```

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select vin, body_type, city, latitude, longitude, make_name, maximum_seating, mileage, model_name, price, seller_rating, transmission, trim_name, year from cargurus_usedcars limit 20;
```

vin	body_type	city	latitude	longitude	make_name	maximum_seating	mileage	model_name	price	seller_rating	transmission	trim_name
ZACNJAB85KP392081	SUV / Crossover	Bayamon	18.3988	-66.1582	Jeep	5 seats	7.0	Renegade	23141.0	2.8	A	Latitude FWD
SALCJ2FX1LH858117	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	7 seats	8.0	Discovery Sport	46500.0	3.0	A	S AWD
JF1VA2M67G9829723	Sedan	Guaynabo	18.3467	-66.1098	Subaru	5 seats		WRX STI	46995.0		M	Base
SALRR2RVOL2433391	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	7 seats	11.0	Discovery	67430.0	3.0	A	V6 HSE AWD
SALCJ2FX1LH862327	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	7 seats	7.0	Discovery Sport	48880.0	3.0	A	S AWD
SALYK2EX1LA261711	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	5 seats	12.0	Range Rover Velar	66903.0	3.0	A	P250 R-Dynamic S AWD
3MZBPABL6KW107908	Sedan	Bayamon	18.3988	-66.1582	Mazda	5 seats	14.0	MAZDA3	23695.0	2.8	A	Sedan FWD
SALYK2EX1LA275434	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	5 seats	11.0	Range Rover Velar	68520.0	3.0	A	P250 R-Dynamic S AWD
SALCJ2FX1LH858128	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	7 seats	8.0	Discovery Sport	51245.0	3.0	A	S AWD
SALZL2GX4LH007593	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	5 seats	254.0	Range Rover Evoque	84399.0	3.0	A	P300 R-Dynamic SE AWD
ZARBAAC41FM129303	Coupe	Guaynabo	18.3467	-66.1098	Alfa Romeo	2 seats	301.0	4C	97579.0		A	Launch Edition Coupe
SALZJ2FX0LH081763	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	5 seats	22.0	Range Rover Evoque	51885.0	3.0	A	P250 S AWD
WBA887C53GK368522	Sedan	Guaynabo	18.3467	-66.1098	BMW	5 seats	6903.0	3 Series	58995.0		A	340i xDrive Sedan AWD
SALYK2EX1LA268316	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	5 seats	20.0	Range Rover Velar	68725.0	3.0	A	P250 R-Dynamic S AWD
3MZBPABL1KW108237	Sedan	Bayamon	18.3988	-66.1582	Mazda	5 seats	204.0	MAZDA3	23695.0	2.8	A	Sedan FWD
3MZBPABL4KW107969	Sedan	Bayamon	18.3988	-66.1582	Mazda	5 seats	61.0	MAZDA3	23695.0	2.8	A	Sedan FWD
SALCP2FX1LH857747	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	7 seats	6.0	Discovery Sport	52275.0	3.0	A	SE AWD
SALYK2EX1LA284533	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	5 seats	7.0	Range Rover Velar	68760.0	3.0	A	P250 R-Dynamic S AWD
SALYK2EX1LA284669	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	5 seats	5.0	Range Rover Velar	68760.0	3.0	A	P250 R-Dynamic S AWD
SALCP2FX1LH854709	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	7 seats	8.0	Discovery Sport	53770.0	3.0	A	SE AWD

20 rows selected (0.25 seconds)

## 6. Creating Hive Queries to Analyze Data

You will create the following tables which will have all the data from the main table. All the subsequent queries will be based on the main table "cargurus\_usedcars".

### 1. The below command will create a table based on the make and model of the car which has more seller ratings in the past 5 years.

**NOTE:** Don't forget to replace **hparekh2** to your account name in the following HQL code.

Copy and paste the following Hive code to Beeline shell to create a table **car\_ratings**:

```
CREATE EXTERNAL TABLE IF NOT EXISTS car_rating (  
make_name string, model_name string, year int, seller_rating string)  
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','  
STORED AS TEXTFILE LOCATION '/user/hparekh2/GP2TermProject/tables/car_rating/';  
  
INSERT OVERWRITE TABLE car_rating  
Select make_name, model_name, year, AVG(seller_rating)  
FROM cargurus_usedcars  
WHERE year >= 2015 and year <= 2020  
GROUP BY make_name, model_name, year;
```

Then, in the beeline shell, you need to check if the tables "**car\_rating**" is shown:

```
show tables;
```

```
describe car_rating
```

Now you can query the content of the table:

```
select * from car_rating LIMIT 5;
```

It will display the result as follows:

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> Select * from car_rating LIMIT 5;
```

car_rating.make_name	car_rating.model_name	car_rating.year	car_rating.seller_rating
Acura	NSX	2020	4.38957153630683
Acura	RLX Hybrid Sport	2019	4.397438423645321
Acura	TLX	2017	4.220877661354583
Alfa Romeo	4C	2015	4.1595165697161995
Alfa Romeo	4C	2018	4.45261250524917

```
5 rows selected (0.204 seconds)
```

## 2. The below command provides N-gram sentiment analysis of top seller rating cars.

**NOTE:** Don't forget to replace **hparekh2** to your account name in the following HQL code.

```
Create table bigram_analysis(new_ar array<struct<ngram:array<string>, estfrequency:double>>);
```

```
INSERT OVERWRITE TABLE bigram_analysis
```

```
Select context_ngrams(sentences(lower(description)), array(null,null),100)as bigram
```

```
FROM cargurus_usedcars
```

```
WHERE make_name IN ('Lotus','Bentley', 'Ferrari', 'Karma', 'Lamborghini', 'Rolls-Royce', 'Porsche',  
'McLaren', 'Aston Martin', 'smart', 'MINI', 'Jaguar', 'Tesla', 'Lexus', 'Audi', 'Land Rover', 'Mercedes')  
AND year >= 2015;
```

```
Create table frequency_bigram (ngram string, estfrequency double)
```

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

```
STORED AS TEXTFILE LOCATION '/user/hparekh2/GP2TermProject/tables/ngramAnalysis/';
```

```
Insert overwrite table frequency_bigram
```

```
Select concat(X.ngram[0], ' ',X.ngram[1]) as bigram, X.estfrequency
```

```
From bigram_analysis LATERAL VIEW explode(new_ar) Z as X;
```

Now you can query the content of the table:

```
select * from frequency_bigram limit 10;
```

It will display the result as follows:

frequency_bigram.ngram	frequency_bigram.estfrequency
steering wheel	435699.0
air bag	183303.0
vanity mirror	169875.0
power door	140672.0
rear seat	132615.0
keyless entry	124803.0
seat power	124400.0
door mirrors	119999.0
a c	119706.0
driver seat	119248.0

### 3. The below query will create a table based on the inventory of cars based on body type and price range for the past 5 years.

**NOTE:** Don't forget to replace **pramdass2** to your account name in the following HQL code.

Copy and paste the following Hive code to Beeline shell to create a table carsPriceRange :

This table will analyse data based on the price range.

```
CREATE TABLE carsPriceRange AS select body_type, price , case when price > 0 and price < 10000 then '0 - 10000' when price > 10000 and price < 20000 then '10000 - 20000' when price > 20000 and price < 30000 then '20000 - 30000' when price > 30000 and price < 40000 then '30000 - 40000' when price > 40000 and price < 50000 then '40000 - 50000' when price > 50000 and price < 60000 then '50000 - 60000' when price > 60000 and price < 70000 then '60000 - 70000' when price > 70000 and price < 80000 then '70000 - 80000' when price > 80000 and price < 90000 then '80000 - 90000' else '90000 - above' end as price_range from cargurus_usedcars where body_type != '' and year >= 2015 and year <= 2020;
```

Now you can query the content of the table:

```
select * from carsPriceRange limit 10;
```

It will display the result as follows:

```
[0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select * from carsPriceRange limit 10;
```

carspricerange.body_type	carspricerange.price	carspricerange.price_range
SUV / Crossover	23141.0	20000 - 30000
SUV / Crossover	46500.0	40000 - 50000
Sedan	46995.0	40000 - 50000
SUV / Crossover	67430.0	60000 - 70000
SUV / Crossover	48880.0	40000 - 50000
SUV / Crossover	66903.0	60000 - 70000
Sedan	23695.0	20000 - 30000
SUV / Crossover	68520.0	60000 - 70000
SUV / Crossover	51245.0	50000 - 60000
SUV / Crossover	84399.0	80000 - 90000

```
10 rows selected (0.119 seconds)
```

Once the carsPriceRange table has been created we will group the data by body type and price range to get the final result.

```
CREATE EXTERNAL TABLE IF NOT EXISTS CarsPriceRangeByBodyType(price_range string, body_type
string,Car_count string) ROW FORMAT DELIMITED FIELDS TERMINATED BY ',' STORED AS TEXTFILE
LOCATION '/user/pramdas2/GP2TermProject/tables/CarsPriceRangeByBodyType/';
```

```
INSERT OVERWRITE TABLE CarsPriceRangeByBodyType select
price_range,body_type,count(price_range) from carsPriceRange group by price_range,body_type
order by price_range;
```

Now you can query the content of the table:

```
select * from CarsPriceRangeByBodyType limit 10;
```

It will display the result something like follows:

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select * from CarsPriceRangeByBodyType limit 10;
```

carspricerangebybodytype.price_range	carspricerangebybodytype.body_type	carspricerangebybodytype.car_count
0 - 10000	Minivan	555
0 - 10000	SUV / Crossover	2142
0 - 10000	Coupe	145
0 - 10000	Convertible	20
0 - 10000	Hatchback	4462
0 - 10000	Pickup Truck	31
0 - 10000	Sedan	13951
0 - 10000	Van	168
0 - 10000	Wagon	928
10000 - 20000	Coupe	4535

4. The below command will create a table based on the make and model of the car to check which will take longer time to sell.

**NOTE:** Don't forget to replace **ssuryaw** to your account name in the following HQL code.

```
CREATE TABLE daysonmarketbydays AS select make_name,model_name, case when daysonmarket > 0  
and daysonmarket < 91 then '0 - 91' when daysonmarket > 91 and daysonmarket < 182 then '91 - 182'  
when daysonmarket > 182 and daysonmarket < 365 then '182 - 365' else '365 - above' end as  
days_range from cargurus_usedcars_1 where  
body_type != '' and year >= 2015 and year <= 2020;
```

Now you can query the content of the table:

```
select * from daysonmarketbydays limit 10;
```

It will display the result as follows:

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select * from daysonmarketbydays LIMIT 10 ;
```

<u>daysonmarketbydays.make_name</u>	<u>daysonmarketbydays.model_name</u>	<u>daysonmarketbydays.days_range</u>
Jeep	Renegade	365 - above
Land Rover	Discovery Sport	182 - 365
Subaru	WRX STI	365 - above
Land Rover	Discovery	182 - 365
Land Rover	Discovery Sport	91 - 182
Land Rover	Range Rover velar	182 - 365
Mazda	MAZDA3	365 - above
Land Rover	Range Rover velar	0 - 91
Land Rover	Discovery Sport	182 - 365
Land Rover	Range Rover Evoque	365 - above

```
CREATE EXTERNAL TABLE IF NOT EXISTS car_market_days_range(make_name string,model_name string,days_range string ,Car_count string) ROW FORMAT DELIMITED FIELDS TERMINATED BY ',' STORED AS TEXTFILE LOCATION '/user/ssuryaw/GP2TermProject/tables/CarsdaysRangeByMake/';
```

```
INSERT OVERWRITE TABLE car_market_days_range select make_name,model_name,days_range,count(days_range) from daysonmarketbydays group by make_name,model_name,days_range order by days_range;
```

Now you can query the content of the table:

```
select * from car_market_days_range limit 10;
```

It will display the result as follows:

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select * from car_market_days_range LIMIT 10;
```

car_market_days_range.make_name	car_market_days_range.model_name	car_market_days_range.days_range	car_market_days_range.car_count
Acura	ILX	0 - 91	2076
Acura	MDX	0 - 91	8135
Acura	MDX Hybrid Sport	0 - 91	187
Acura	NSX	0 - 91	27
Acura	RDX	0 - 91	3395
Acura	RLX	0 - 91	130
Acura	RLX Hybrid Sport	0 - 91	53
Acura	TLX	0 - 91	3847
Alfa Romeo	4C	0 - 91	14
Alfa Romeo	Giulia	0 - 91	1456

```
10 rows selected (0.108 seconds)
```

## 5. The below command will create a table based on the inventory of cars having more accidents.

```
CREATE EXTERNAL TABLE IF NOT EXISTS car_has_accidents_model (
  make_name string, model_name string, year int, car_has_accidents string, has_accidents_count string)
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
STORED AS TEXTFILE LOCATION '/user/ssuryaw/GP2TermProject/tables/CarsHasAccidentByMake/' ;

INSERT OVERWRITE TABLE car_has_accidents_model
Select make_name, model_name, has_accidents, count(has_accidents)
FROM cargurus_usedcars_1
WHERE year >= 2005 and year <= 2020
GROUP BY make_name, model_name, year , has_accidents;
```

Now you can query the content of the table:

```
select * from car_has_accidents_model limit 10;
```

It will display the result as follows:



```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select * from car_has_accidents_model LIMIT 10;
```

car_has_accidents_model.make_name	car_has_accidents_model.model_name	car_has_accidents_model.year	car_has_accidents_model.car_has_accidents	car_has_accidents_model.has_accidents_count
Acura	ILX	2013	False	56
Acura	ILX	2017	True	102
Acura	MDX	2008	True	64
Acura	MDX	2012	False	184
Acura	MDX	2014		1
Acura	MDX	2017	False	1747
Acura	MDX Hybrid Sport	2019	False	13
Acura	MDX Hybrid Sport	2020	False	7
Acura	NSX	2019	True	1
Acura	RDX	2018		2

10 rows selected (0.248 seconds)

**6. The below command will create a table based on the inventory of used cars by body type.**

**NOTE:** Don't forget to replace **vmuthup** to your account name in the following HQL code.

```
CREATE TABLE IF NOT EXISTS count_by_bodytype ROW FORMAT DELIMITED FIELDS TERMINATED BY ":" STORED AS TEXTFILE LOCATION "/user/vmuthup/GP2TermProject/tables/bodytype" AS select body_type as BodyType, count(vin) as total from cargurus_usedcars group by body_type having count(vin) > 100 and trim(body_type) != "" and body_type is NOT NULL order by body_type;
```

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select * from count_by_bodytype;
```

count_by_bodytype.body_type	count_by_bodytype.total
Convertible	26010
Coupe	71607
Hatchback	88374
Minivan	79802
Pickup Truck	474595
SUV / Crossover	1416402
Sedan	742036
Van	47166
Wagon	40505

9 rows selected (0.078 seconds)

7. The below command will create a table showing inventory of used cars by year.

**NOTE:** Don't forget to replace **hparekh2** to your account name in the following HQL code.

```
CREATE EXTERNAL TABLE IF NOT EXISTS inventory_car (year int, no_of_cars int) ROW FORMAT  
DELIMITED FIELDS TERMINATED BY ',' STORED AS TEXTFILE LOCATION  
'/user/hparekh2/GP2TermProject/tables/inventory_car';  
  
INSERT OVERWRITE TABLE inventory_car SELECT year, Count(*) FROM cargurus_usedcars WHERE  
year > 2005 GROUP BY year;
```

Now you can query the content of the table:

```
select * from inventory_car limit 10;
```

It will display the result as follows:

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> Select * from inventory_car LIMIT 10;  
+-----+-----+  
| inventory_car.year | inventory_car.no_of_cars |  
+-----+-----+  
| 2009               | 22567                    |  
| 2007               | 22866                    |  
| 2008               | 27638                    |  
| 2006               | 16580                    |  
| 2013               | 67903                    |  
| 2020               | 1349815                  |  
| 2016               | 122201                   |  
| 2010               | 31470                    |  
| 2015               | 92554                    |  
| 2019               | 284650                   |  
+-----+-----+  
10 rows selected (0.106 seconds)
```

## 8. The below command will create a table showing inventory of used cars by body styles and geographical location of the past ten years.

**NOTE:** Don't forget to replace **syadav5** to your account name in the following HQL code.

```
CREATE EXTERNAL TABLE IF NOT EXISTS bodystyle_region(body_type string, city string, latitude string, longitude string, make_name string, year string)
ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
STORED AS TEXTFILE LOCATION '/user/syadav5/GP2TermProject/tables/bodystyle_region/';

INSERT OVERWRITE TABLE bodystyle_region
SELECT body_type, city, latitude, longitude, make_name, year from cargurus_usedcars
where body_type != '' and year >= 2010 and year <= 2020 and year != '';
```

```
0: jdbc:hive2://bigdai-nov-bdcsce-1:2181,bigd> select * from bodystyle_region limit 10;
```

bodystyle_region.body_type	bodystyle_region.city	bodystyle_region.latitude	bodystyle_region.longitude	bodystyle_region.make_name	bodystyle_region.year
SUV / Crossover	Bayamon	18.3988	-66.1582	Jeep	2019
SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
Sedan	Guaynabo	18.3467	-66.1098	Subaru	2016
SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
Sedan	Bayamon	18.3988	-66.1582	Mazda	2019
SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020

10 rows selected (0.076 seconds)

## 7. Downloading data into your PC

After the Hive tables are created, you can download it to your lab (or personal PC/Laptop) as follows.

1. Switch on to the first terminal connected to the Oracle cloud to download the output file at the HDFS path.

```
$ ssh syadav5@ipaddress
syadav5@ipaddress's password:
```

Run the following command to check if files are present:

```
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/car_rating
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/ngramAnalysis
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/CarsPriceRangeByBodyType
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/CarsdaysRangeByMake
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/CarsHasAccidentByMake
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/bodytype
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/bodystyle_region
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/inventory_car
```

```
-bash-4.1$ hdfs dfs -ls GP2TermProject/tables/bodystyle_region
Found 1 items
-rwxr-xrwx  2 bdcscs_admin hdfs  135289281 2020-11-20 01:06 GP2TermProject/tables/bodystyle_region/000000_0
-bash-4.1$
```

You will see only one file named 000000\_0 is present in all the following folders:

```
$ hdfs dfs -ls GP2TermProject/tables/CarsPriceRangeByBodyType/000000_0
$ hdfs dfs -ls GP2TermProject/tables/bodytype/000000_0
$ hdfs dfs -ls GP2TermProject/tables/bodystyle_region/000000_0
```

Except at the following locations. The latter locations have multiple files and will need a merge.

```
GP2TermProject/tables/car_rating
GP2TermProject/tables/ngramAnalysis
GP2TermProject/tables/CarsdaysRangeByMake
GP2TermProject/tables/CarsHasAccidentByMake
GP2TermProject/tables/inventory_car
```

2. Download the output files to the local file systems and rename it

Since all the folders have the same name file 000000\_0, after downloading into local file system you will rename the file

```
-bash-4.1$ hdfs dfs -get GP2TermProject/tables/bodystyle_region/000000_0  
  
-bash-4.1$ ls  
000000_0
```

Copy the “000000\_0” file content to region.csv and verify if the file exists.

```
-bash-4.1$ cat 000000_0 > region.csv  
-bash-4.1$ ls  
000000_0 region.csv  
-bash-4.1$
```

Similarly, do it for the other files.

```
-bash-4.1$ hdfs dfs -get GP2TermProject/tables/CarsPriceRangeByBodyType/000000_0  
cat 000000_0 > carsPriceRangeByBodyType.csv  
  
-bash-4.1$ hdfs dfs -get GP2TermProject/tables/bodytype/000000_0  
cat 000000_0 > bodytype_result.csv
```

3. Now, you have to merge multiples files (for the directories car\_rating, ngramAnalysis, CarsdaysRangeByMake, CarsHasAccidentByMake, inventory\_car) into a single output file using the following commands:

```
-bash-4.1$ hdfs dfs -cat GP2TermProject/tables/car_rating/00*_0 | hdfs dfs -put -  
GP2TermProject/tables/car_rating/seller_rating.csv
```

```
-bash-4.1$ hdfs dfs -cat GP2TermProject/tables/ngramAnalysis/00*_0 | hdfs dfs -put -  
GP2TermProject/tables/ngramAnalysis/bigram.csv
```

```
-bash-4.1$ hdfs dfs -cat GP2TermProject/tables/CarsdaysRangeByMake/00*_0 | hdfs dfs -put -  
GP2TermProject/tables/CarsdaysRangeByMake/days_range_data.csv
```

```
-bash-4.1$ hdfs dfs -cat GP2TermProject/tables/CarsHasAccidentByMake/00*_0 | hdfs dfs -put -  
GP2TermProject/tables/CarsHasAccidentByMake/hasaccidentsBymake.csv
```

```
-bash-4.1$ hdfs dfs -cat GP2TermProject/tables/inventory_car/00*_0 | hdfs dfs -put -  
GP2TermProject/tables/inventory_car/inventory_car.csv
```

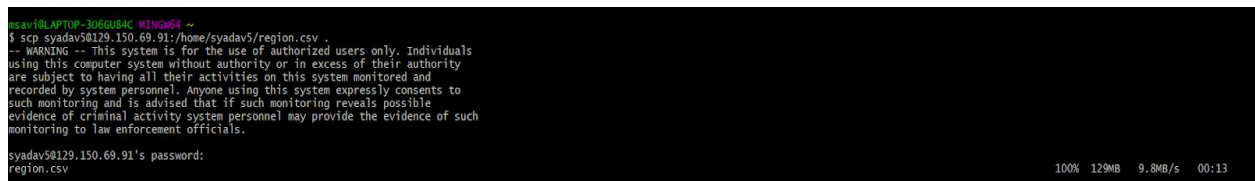
Download the output file using the following command:

```
-bash-4.1$ hdfs dfs -get GP2TermProject/tables/car_rating/seller_rating.csv
```

Likewise, do it for other files.

4. Open another terminal with git bash in order to import the output file using your lab computer (or your PC/Laptop) - you have to download the file to your lab computer (or your PC/Laptop). For example, your output file at the oracle cloud server is located at /home/**syadav5**/region.csv and remotely download the file.

```
$ scp syadav5@ipaddress:/home/syadav5/region.csv .
```



```
msavi@LAPTOP-306GU84C MINGW64 ~  
$ scp syadav5@129.150.69.91:/home/syadav5/region.csv .  
- WARNING - This system is for the use of authorized users only. Individuals  
using this computer system without authority or in excess of their authority  
are subject to having all their activities on this system monitored and  
recorded by system personnel. Anyone using this system expressly consents to  
such monitoring and is advised that if such monitoring reveals possible  
evidence of criminal activity system personnel may provide the evidence of such  
monitoring to law enforcement officials.  
syadav5@129.150.69.91's password:  
region.csv  
100% 129MB 9.8MB/s 00:13
```

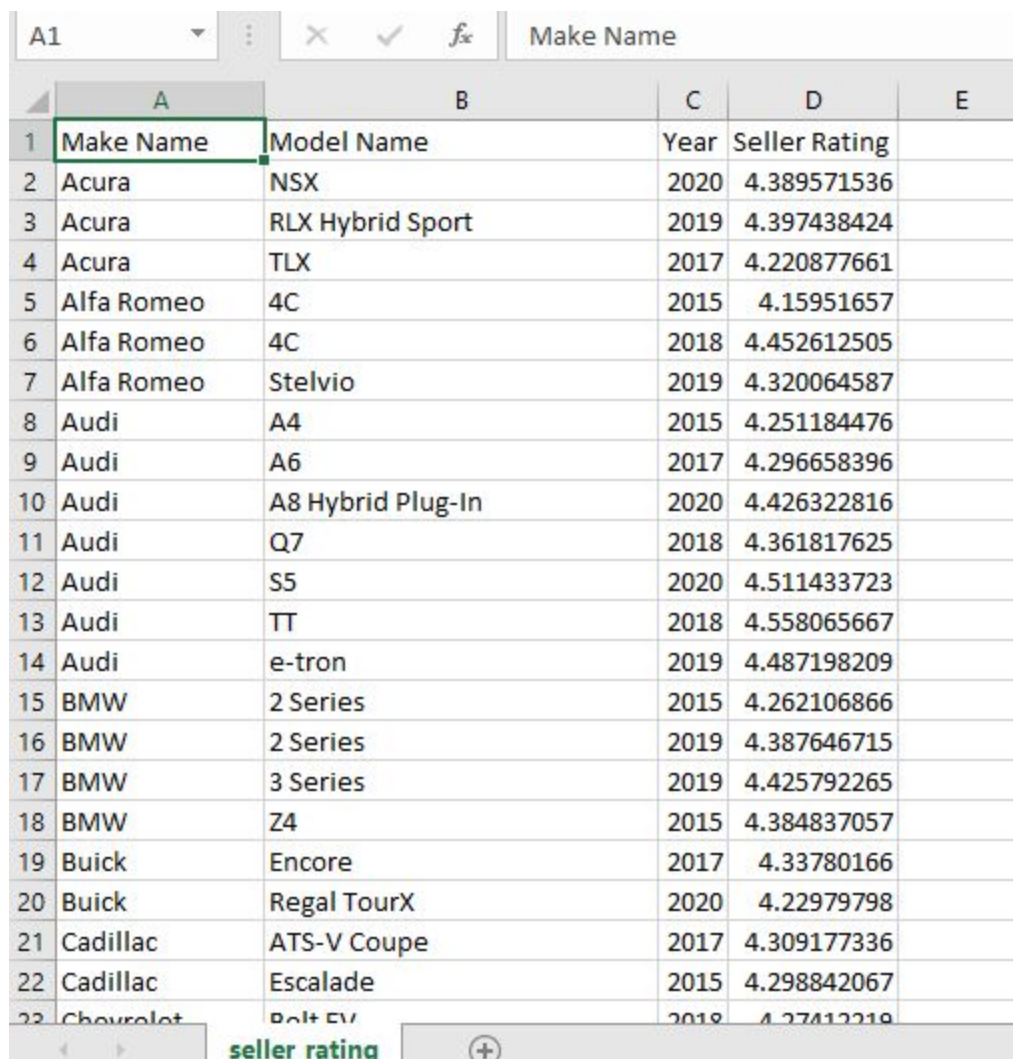
Similarly, do it for other files.

## 8. Visualizing Data

### 1. Seller rating of car brand and its models.

- a) Open the seller\_rating.csv file in Microsoft Excel. For the first row of the file, you need to insert the header to each column as follows:

**Make Name    Model Name    Year    Seller Rating**

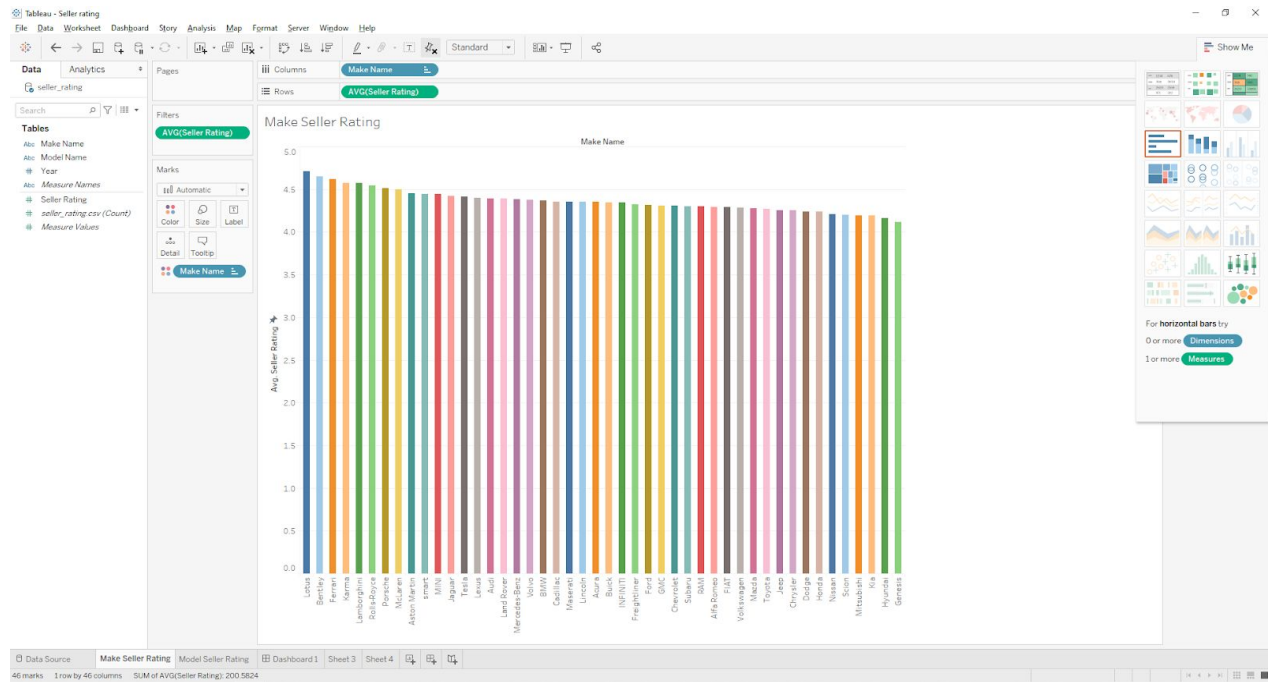


	A	B	C	D	E
1	Make Name	Model Name	Year	Seller Rating	
2	Acura	NSX	2020	4.389571536	
3	Acura	RLX Hybrid Sport	2019	4.397438424	
4	Acura	TLX	2017	4.220877661	
5	Alfa Romeo	4C	2015	4.15951657	
6	Alfa Romeo	4C	2018	4.452612505	
7	Alfa Romeo	Stelvio	2019	4.320064587	
8	Audi	A4	2015	4.251184476	
9	Audi	A6	2017	4.296658396	
10	Audi	A8 Hybrid Plug-In	2020	4.426322816	
11	Audi	Q7	2018	4.361817625	
12	Audi	S5	2020	4.511433723	
13	Audi	TT	2018	4.558065667	
14	Audi	e-tron	2019	4.487198209	
15	BMW	2 Series	2015	4.262106866	
16	BMW	2 Series	2019	4.387646715	
17	BMW	3 Series	2019	4.425792265	
18	BMW	Z4	2015	4.384837057	
19	Buick	Encore	2017	4.33780166	
20	Buick	Regal TourX	2020	4.22979798	
21	Cadillac	ATS-V Coupe	2017	4.309177336	
22	Cadillac	Escalade	2015	4.298842067	
23	Chevrolet	Bolt EV	2018	4.27412219	

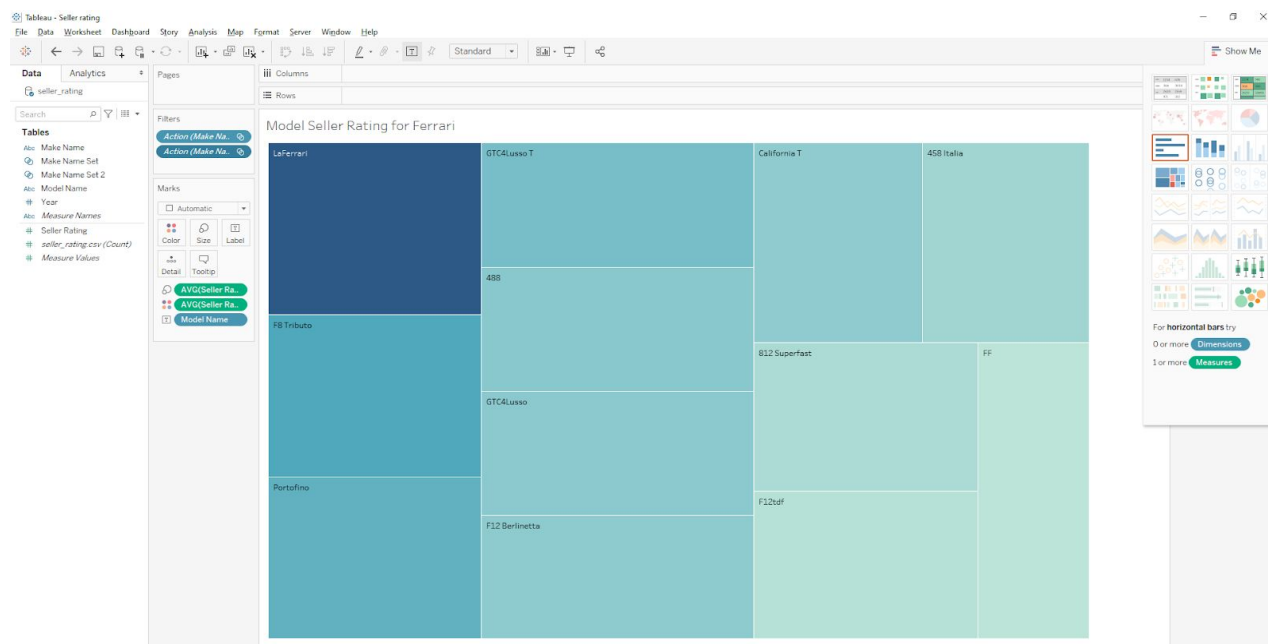
- b) Open Tableau. Import the excel sheet.



- c) Select graph Horizontal bars. Drag Make-Name in columns and Seller rating in rows. Change the seller rating aggregation to AVG and choose for Make-Name in color tab.

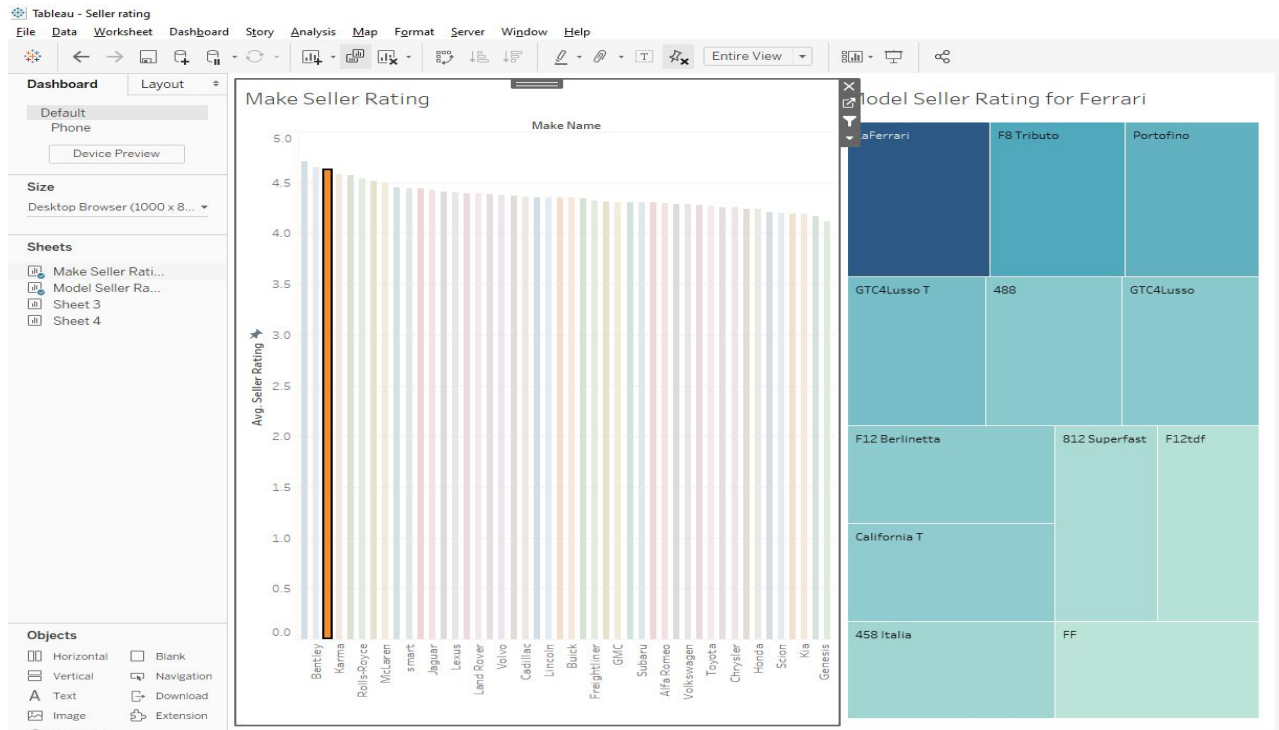


- d) Select treemap. Drag Model-Name in columns and AVG (seller rating) in rows. Filter Make Name set and set 2.





e) Click on the dashboard and drag both the above worksheets to see the below results.



## 2. N-gram sentiment analysis of top seller rating cars.

- Open the bigram.csv file in Microsoft Excel. For the first row of the file, you need to insert the header to each column as follows:

**word      Frequency**

	A	B	C
1	Word	Frequency	
2	air bag	183303	
3	keyless entry	124803	
4	camera	132653	
5	intermittent wipers	117791	
6	trip computer	115141	
7	traction control	112051	
8	stability control	106799	
9	air conditioning	103819	
10	center armrest	101312	
11	tire pressure	100167	
12	power steering	95276	
13	reading lights	94844	
14	cruise control	94718	
15	impact airbags	94082	
16	anti-roll bar	92587	
17	disc brakes	84462	
18	navigation system	76844	
19	leather steering	74156	
20	mirrors power	73513	
21	passenger vanity	72484	
22	driver vanity	72223	
23	rain sensing	70921	

b. Using SAP predictive Expert Analytics

SAP BusinessObjects Predictive Analytics®

File Help

Data Manager

Automated Analytics

Modeler

Social

Recommendation

Expert Analytics

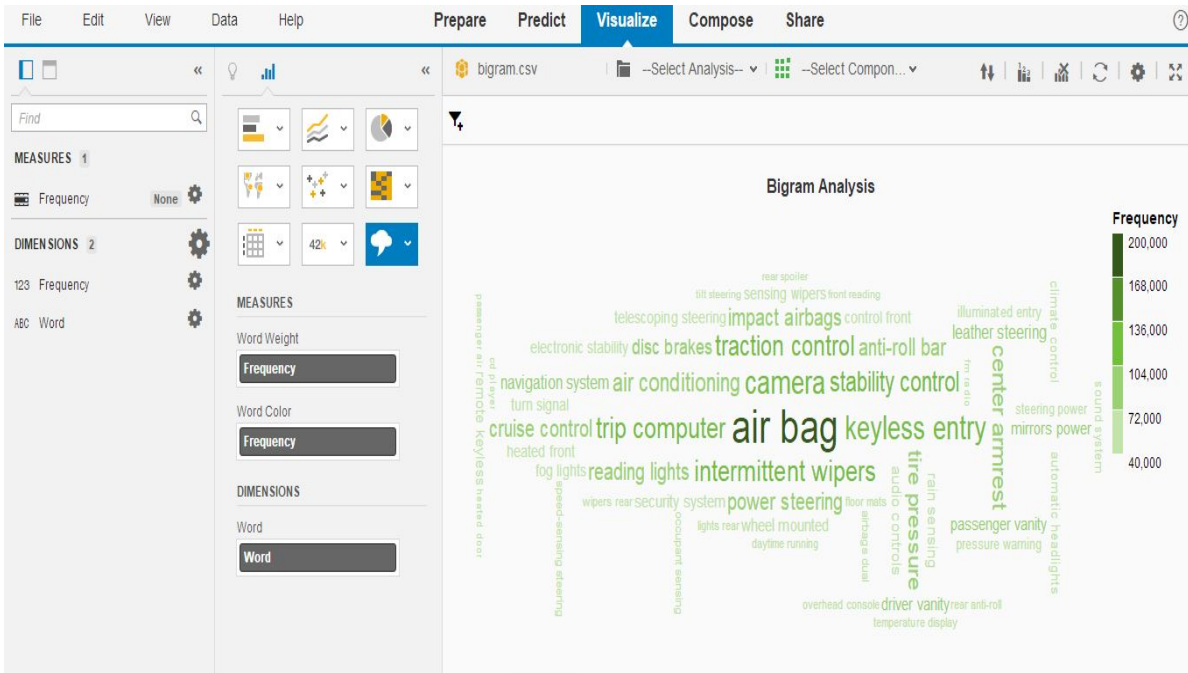
Toolkit

Welcome to

**SAP BusinessObjects  
Predictive Analytics®**

Expert Analytics

- c. Importing the excel sheet and drawing a tag cloud
  - Filtering frequency as measure and words as dimension in order to get the required results.



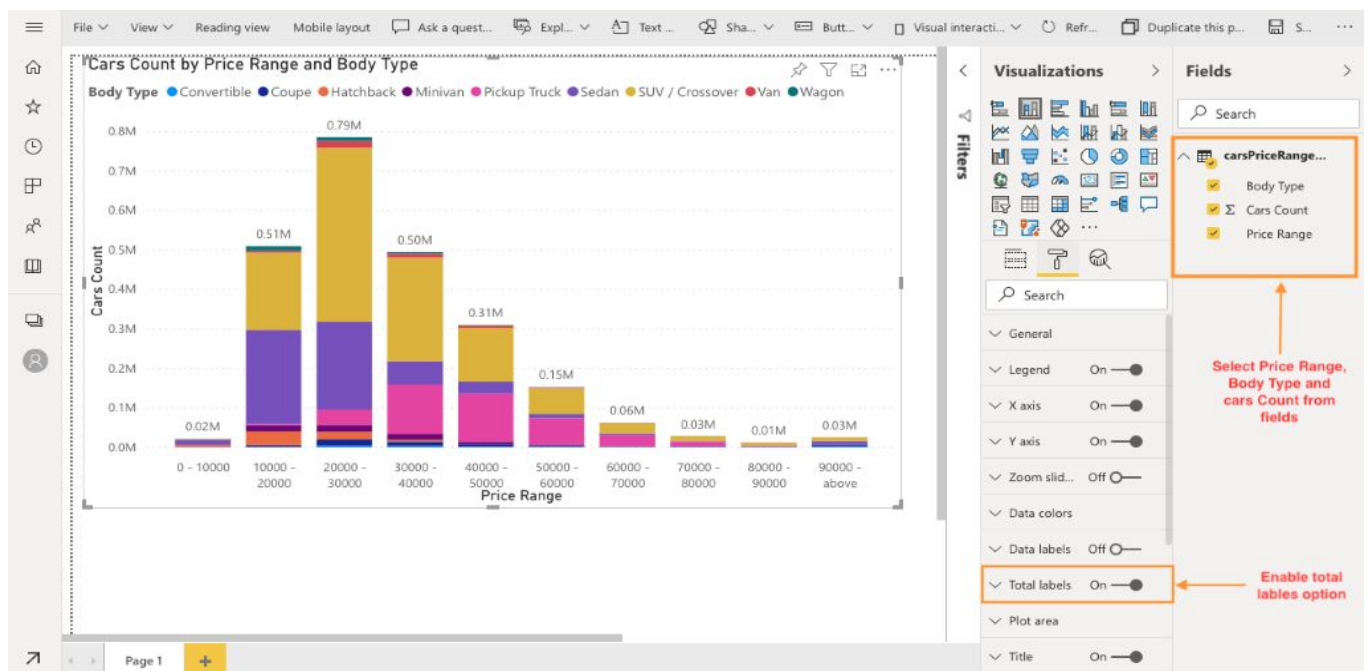
### 3. Inventory of cars by body type and price range

- a. Open the carsPriceRangeByBodyType.csv file with Microsoft Excel and insert the header to each column as follows:

Price Range	Body Type	Cars Count
-------------	-----------	------------

	Price Range			
	A	B	C	D
1	Price Range	Body Type	Cars Count	
2	0 - 10000	Minivan	555	
3	0 - 10000	SUV / Crossover	2142	
4	0 - 10000	Coupe	145	
5	0 - 10000	Convertible	20	
6	0 - 10000	Hatchback	4462	
7	0 - 10000	Pickup Truck	31	
8	0 - 10000	Sedan	13951	
9	0 - 10000	Van	168	
10	0 - 10000	Wagon	928	
11	10000 - 20000	Coupe	4535	
12	10000 - 20000	Hatchback	34803	
13	10000 - 20000	Pickup Truck	3621	
14	10000 - 20000	SUV / Crossover	196341	
15	10000 - 20000	Van	4453	
16	10000 - 20000	Convertible	636	
17	10000 - 20000	Minivan	15403	
18	10000 - 20000	Sedan	238366	
19	10000 - 20000	Wagon	11440	
20	20000 - 30000	Sedan	222446	
21	20000 - 30000	Minivan	17652	
22	20000 - 30000	Wagon	9855	
23	20000 - 30000	Coupe	15828	
24	20000 - 30000	Convertible	3802	

- b. Upload the updated csv file to Power BI and select the stacked column chart. Then select the fields to generate the graph.

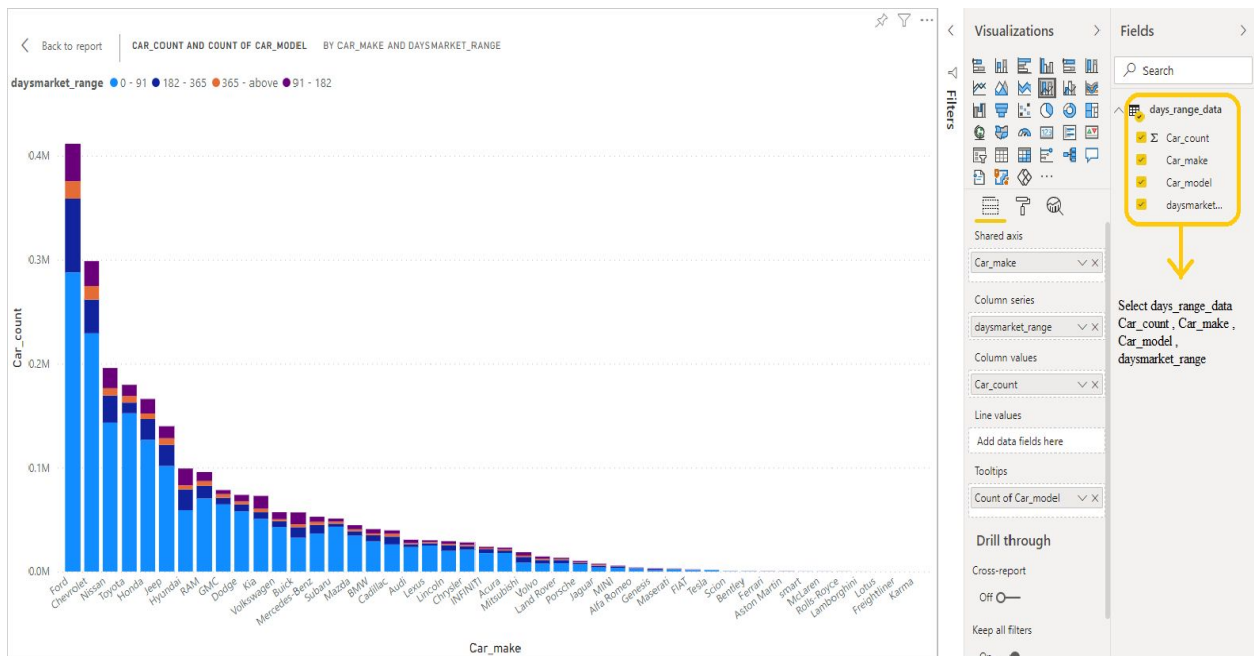


#### 4. Inventory of cars based on the make and model of the car to check which will take longer time to sell.

- Open the days\_range\_data.csv file with Microsoft Excel and insert the header to each column as follows:

**Car\_make    Car\_model    daysmarket\_range    Car\_count**

	A	B	C	D
1	Car_make	Car_model	daysmarket_range	Car_count
2	Acura	ILX	0 - 91	2076
3	Acura	MDX	0 - 91	8135
4	Acura	MDX Hybrid Sport	0 - 91	187
5	Acura	NSX	0 - 91	27
6	Acura	RDX	0 - 91	3395
7	Acura	RLX	0 - 91	130
8	Acura	RLX Hybrid Sport	0 - 91	53
9	Acura	TLX	0 - 91	3847
10	Alfa Romeo	4C	0 - 91	14
11	Alfa Romeo	Giulia	0 - 91	1456
12	Alfa Romeo	Stelvio	0 - 91	1201
13	Aston Martin	DB11	0 - 91	58
14	Aston Martin	DB9	0 - 91	7
15	Aston Martin	DBS	0 - 91	15
16	Aston Martin	Rapide	0 - 91	7
17	Aston Martin	V12 Vantage	0 - 91	9
18	Aston Martin	V8 Vantage	0 - 91	6
19	Aston Martin	Vanquish	0 - 91	15
20	Aston Martin	Vantage	0 - 91	39
21	Audi	A3	0 - 91	2216
22	Audi	A3 Sportback	0 - 91	194
23	Audi	A4	0 - 91	2704
24	Audi	A4 Allroad	0 - 91	185
25	Audi	A5	0 - 91	449
26	Audi	A5 Sportback	0 - 91	809
27	Audi	A6	0 - 91	1835
28	Audi	A6 Allroad	0 - 91	94
29	Audi	A7	0 - 91	338
days_range_data				



## 5. Inventory of cars by more accidents

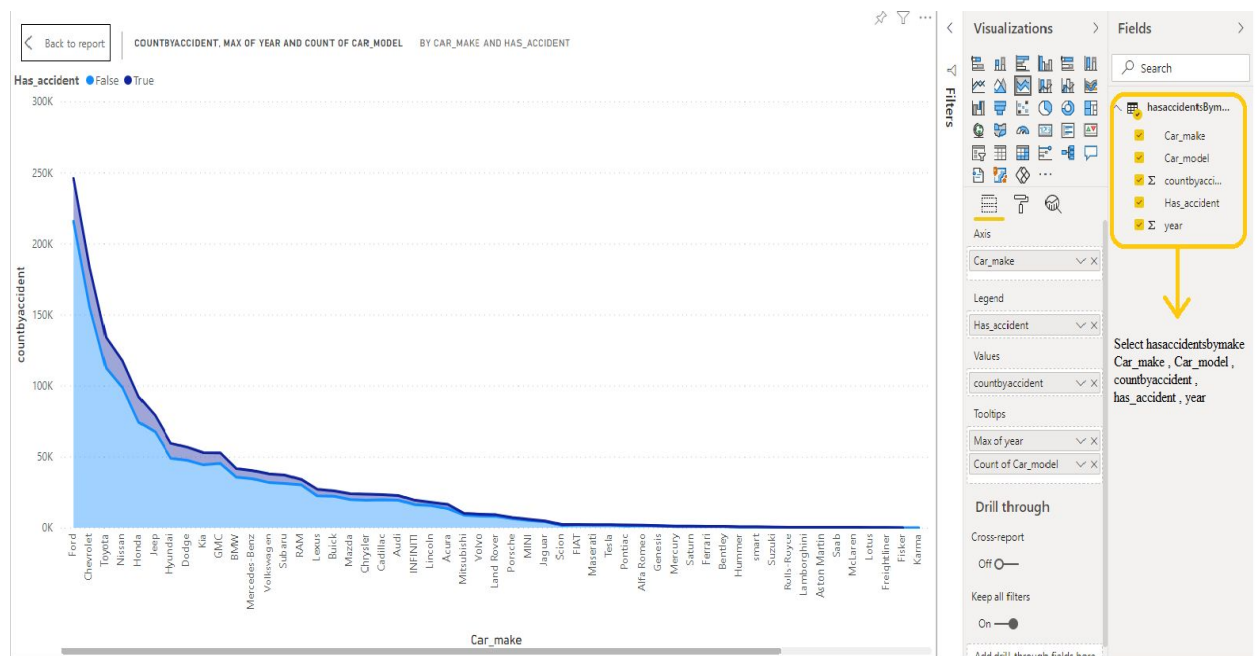
- Open the file hasaccidentsBymake.csv with Microsoft Excel and insert the header to each column as follows:

**Car\_make    Car\_model    year    Has\_accident    countbyaccident**



	A	B	C	D	E
1	Car_make	Car_model	year	Has_accident	countbyaccident
2	Acura	ILX	2013	FALSE	56
3	Acura	ILX	2017	TRUE	102
4	Acura	MDX	2008	TRUE	64
5	Acura	MDX	2012	FALSE	184
6	Acura	MDX	2014		1
7	Acura	MDX	2017	FALSE	1747
8	Acura	MDX Hybrid Sport	2019	FALSE	13
9	Acura	MDX Hybrid Sport	2020	FALSE	7
10	Acura	NSX	2019	TRUE	1
11	Acura	RDX	2018		2
12	Acura	RL	2007	TRUE	2
13	Acura	RSX	2005	FALSE	6
14	Acura	RSX	2005	TRUE	3
15	Acura	TLX	2016	TRUE	50
16	Acura	TLX	2019	FALSE	318
17	Acura	TSX	2014	FALSE	17
18	Alfa Romeo	4C	2018	FALSE	7
19	Alfa Romeo	Giulia	2017	FALSE	396
20	Alfa Romeo	Stelvio	2020	FALSE	16
21	Aston Martin	Rapide	2012	TRUE	1
22	Aston Martin	V8 Vantage	2012	TRUE	1
23	Aston Martin	Vanquish	2015	FALSE	6
24	Audi	A3	2015	TRUE	55
25	Audi	A3	2016	FALSE	230
26	Audi	A3	2019	FALSE	101
27	Audi	A3 Sportback	2018	TRUE	1
28	Audi	A4	2010		1
29	Audi	A4	2017	TRUE	179

- b. Upload the csv file to Power BI and select the stacked column chart. Then select the fields to generate the graph.



## 6. Inventory of cars by body type

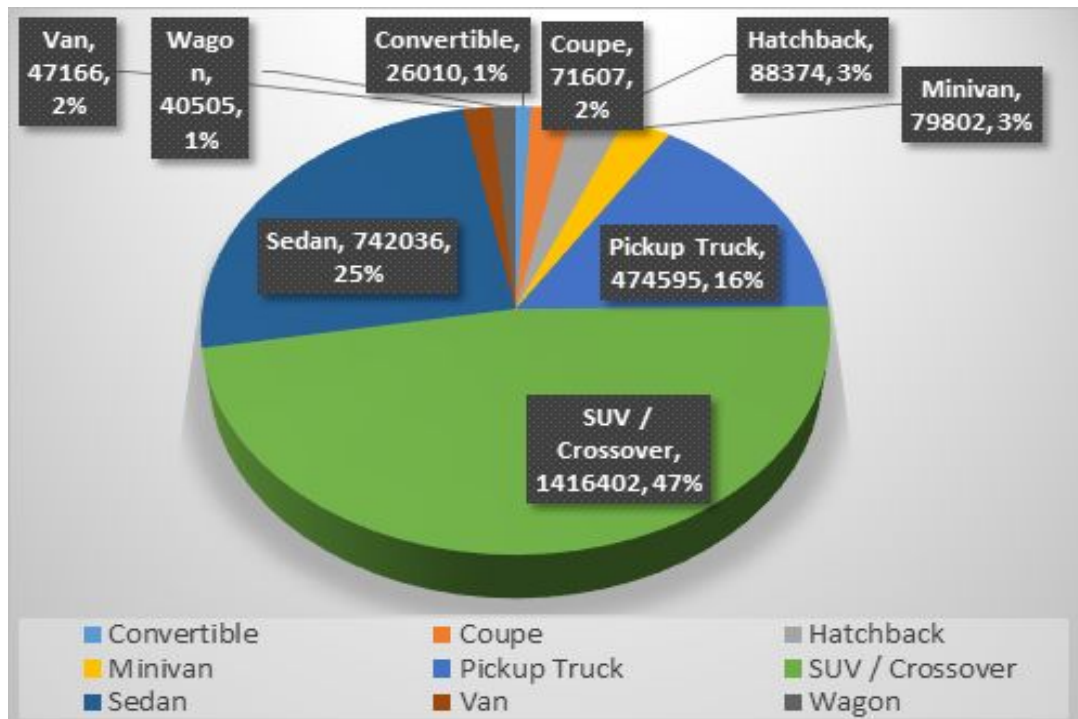
- a. Open the bodytype\_result.csv file with Microsoft Excel and insert the header to each column as follows:

**BodyType**   **Count**

	A	B
1	BodyType	Count
2	Convertible	26010
3	Coupe	71607
4	Hatchback	88374
5	Minivan	79802
6	Pickup Truck	474595
7	SUV / Crossover	1416402
8	Sedan	742036
9	Van	47166
10	Wagon	40505

- b. Go to the "insert" tab to find the pie chart option. You need to click and open "3-D Pie".





## 7. Inventory of car by Year

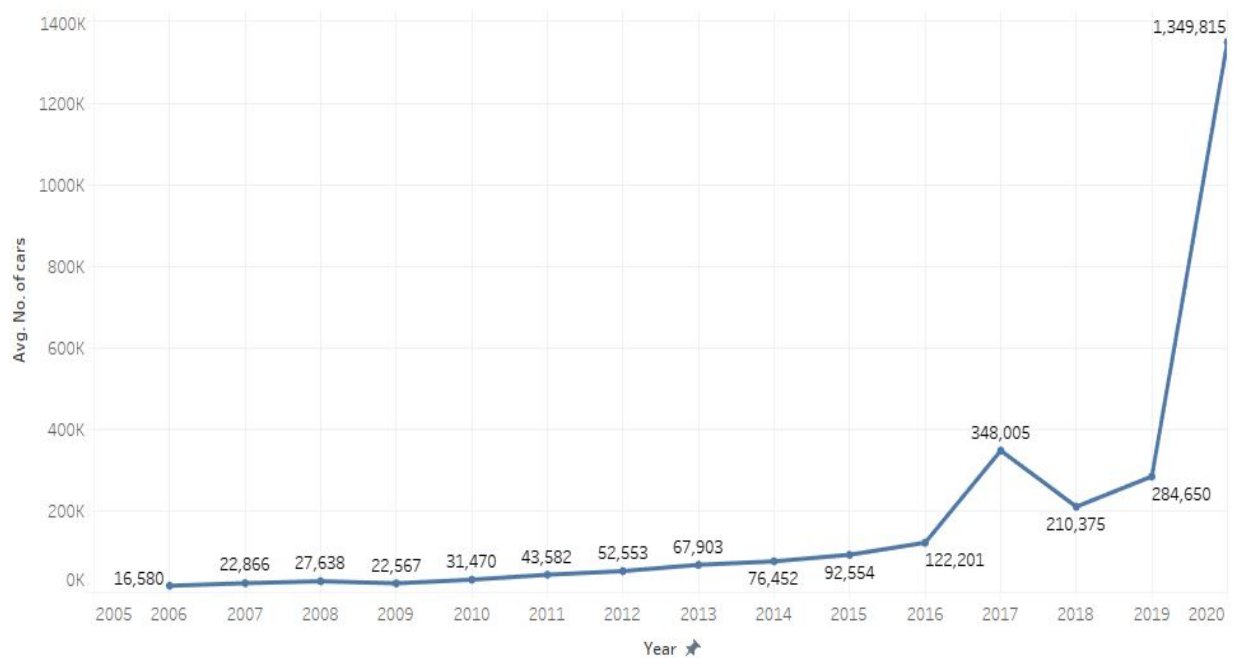
- Open the inventory\_car.csv file in Microsoft Excel. For the first row of the file, you need to insert the header to each column as follows:

**year    No. of cars**

	A	B
1	Year	No. of cars
2	2009	22567
3	2007	22866
4	2008	27638
5	2006	16580
6	2013	67903
7	2020	1349815
8	2016	122201
9	2010	31470
10	2015	92554
11	2019	284650
12	2011	43582
13	2014	76452
14	2017	348005
15	2018	210375
16	2012	52553

- b. Open Tableau and Import car\_inventory.csv . Next Drag no.of cars in rows and year in columns.  
Click on the Show labels.

Sheet 1



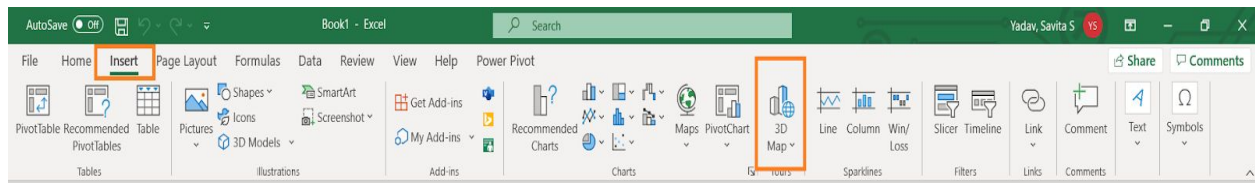
## 8. Geospatial representation of inventory of used cars by body types and region.

- Open the region.csv file in Microsoft Excel. For the first row of the file, you need to insert the header to each column as follows:

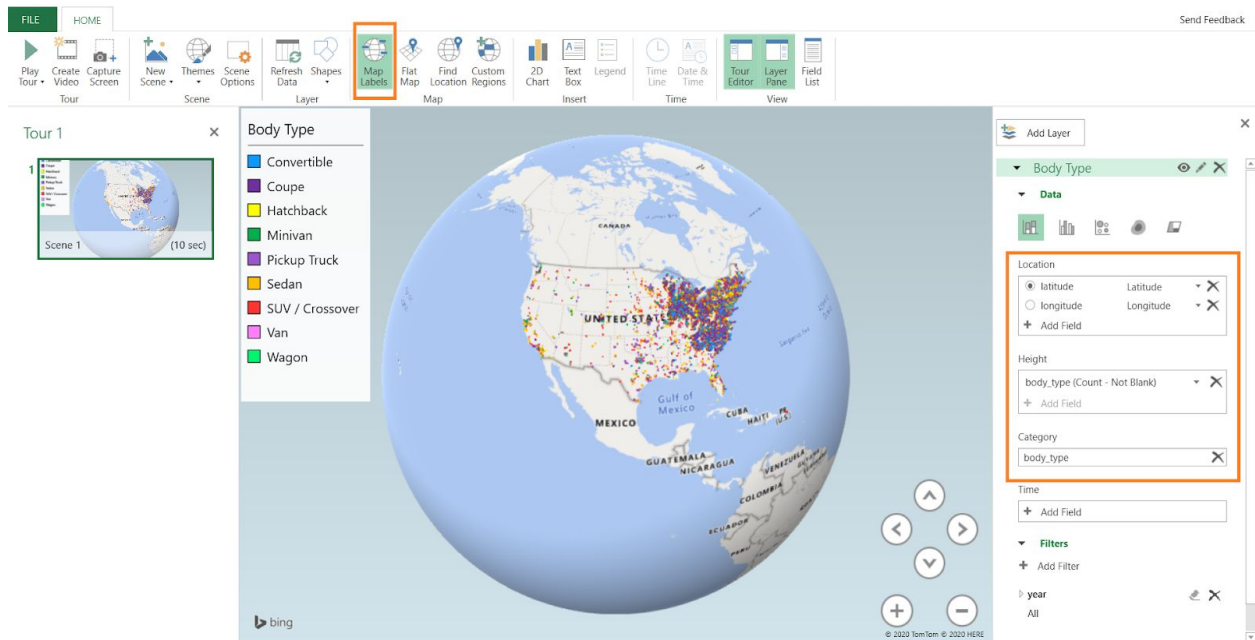
**body\_type   city   latitude   longitude   make\_name   year**

	A	B	C	D	E	F
1	body_type	city	latitude	longitude	make_name	year
2	SUV / Crossover	Bayamon	18.3988	-66.1582	Jeep	2019
3	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
4	Sedan	Guaynabo	18.3467	-66.1098	Subaru	2016
5	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
6	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
7	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
8	Sedan	Bayamon	18.3988	-66.1582	Mazda	2019
9	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
10	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
11	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
12	Coupe	Guaynabo	18.3467	-66.1098	Alfa Romeo	2015
13	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
14	Sedan	Guaynabo	18.3467	-66.1098	BMW	2016
15	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
16	Sedan	Bayamon	18.3988	-66.1582	Mazda	2019
17	Sedan	Bayamon	18.3988	-66.1582	Mazda	2019
18	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
19	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
20	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
21	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
22	Sedan	Bayamon	18.3988	-66.1582	Mazda	2019
23	Sedan	Bayamon	18.3988	-66.1582	Mazda	2019
24	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
25	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
26	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
27	SUV / Crossover	San Juan	18.4439	-66.0785	Land Rover	2020
28	SUV / Crossover	Bayamon	18.3988	-66.1582	Mazda	2019
29	SUV / Crossover	Bayamon	18.3988	-66.1582	Jeep	2019

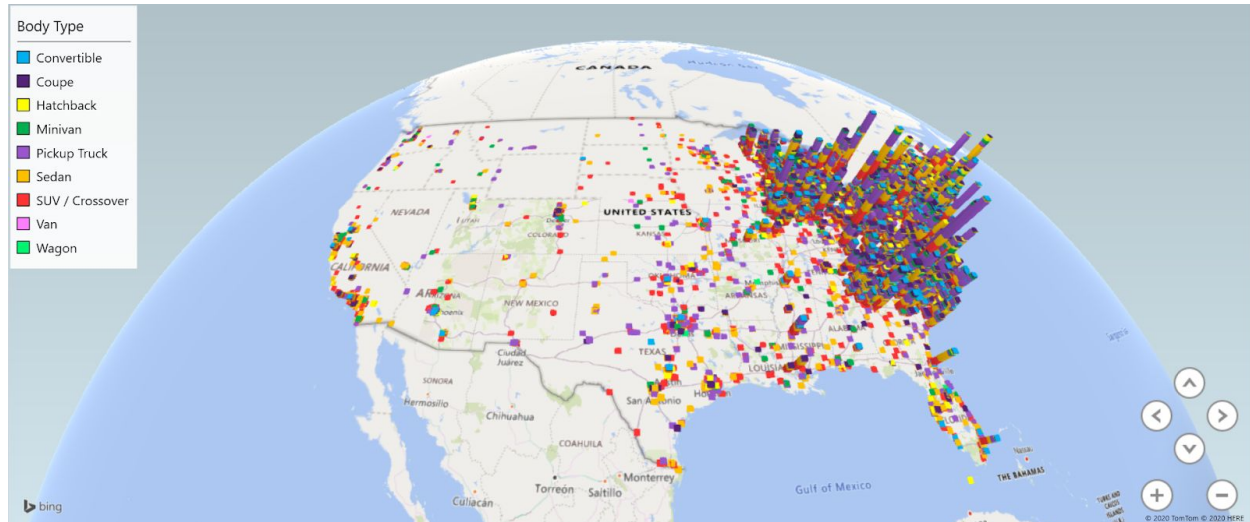
- Save the file as excel format, that is, as region.xlsx.
- Go to the "insert" tab to find the menu "3D Map" enabled – only excel file in xlsx should enable "3D Map". You need to click and open "3D Map".



- d. If it complains that 3D Map cannot be open, then you need to make sure if you insert headers into the first row:
- e. You will see the 3D map.
- f. **NOTE:** If you don't see the layer frame in the right side, you may select all data manually before opening 3D map
- g. Add the properties and values in the layer as follows



- h. Now you can kill the "tour1" frame in the left.
- i. You will get a view like below. You can observe sales and popular body styles by region.



## Summary

In this tutorial you learned how Oracle Cloud Big Data can be used to analyze different forms of raw data using Apache Hive. You went through a flow to understand how the raw data is first uploaded to HDFS, and then loaded to Hive tables for performing queries. Finally, you learned how to import the results of Hive queries and to create visualizations using tableau, Microsoft Power BI and 3D Map chart in MS-excel.

## References

1. URL of data source: <https://www.kaggle.com/ananyamital/us-used-cars-dataset>
2. URL of GitHub: <https://github.com/MRPriya/UsedCarSet>
3. URL to download data source: <http://usedcardataset.s3.amazonaws.com/archive.zip>