United States Airlines Analysis

In [1]:
```
# Let's import the necessary Dependencies.
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")
```

1. Import and aggregate data:

In [2]:
```
airline = pd.read_excel("Airlines.xlsx")
```

In [3]:
```
airline.head()
```

Out[3]:

	id	Airline	Flight	AirportFrom	AirportTo	DayOfWeek	Time	Length	Delay
0	1	CO	269	SFO	IAH	3	15	205	1
1	2	US	1558	PHX	CLT	3	15	222	1
2	3	AA	2400	LAX	DFW	3	20	165	1
3	4	AA	2466	SFO	DFW	3	20	195	1
4	5	AS	108	ANC	SEA	3	30	202	0

In [4]:
```
airline.shape
```

Out[4]:
```
(518556, 9)
```

In [5]:
```
airport= pd.read_excel("airports.xlsx")
```

In [6]:
```
airport.head()
```

Out[6]:

	id	ident	type	name	latitude_deg	longitude_deg	elevation_ft	continent	iso_cou
0	6523	00A	heliport	Total Rf Heliport	40.070801	-74.933601	11.0	NaN	
1	323361	00AA	small_airport	Aero B Ranch Airport	38.704022	-101.473911	3435.0	NaN	
2	6524	00AK	small_airport	Lowell Field	59.947733	-151.692524	450.0	NaN	
3	6525	00AL	small_airport	Epps Airpark	34.864799	-86.770302	820.0	NaN	
4	6526	00AR	closed	Newport Hospital & Clinic Heliport	35.608700	-91.254898	237.0	NaN	

In [7]:
```
airport.shape
```
Out[7]:
```
(73805, 18)
```

In [8]:
```
runway = pd.read_excel("runways.xlsx")
```

In [9]:
```
runway.head()
```
Out[9]:

	id	airport_ref	airport_ident	length_ft	width_ft	surface	lighted	closed	le_ident	le_latitud
0	269408	6523	00A	80.0	80.0	ASPH-G	1	0	H1	
1	255155	6524	00AK	2500.0	70.0	GRVL	0	0	N	
2	254165	6525	00AL	2300.0	200.0	TURF	0	0	1	
3	270932	6526	00AR	40.0	40.0	GRASS	0	0	H1	
4	322128	322127	00AS	1450.0	60.0	Turf	0	0	1	

In [10]:
```
runway.shape
```
Out[10]:
```
(43977, 20)
```

- ### Before Aggregating The Data Lets Drop The Columns Which Are Not Important In Anaylsis

In [11]:
```
runway.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 43977 entries, 0 to 43976
Data columns (total 20 columns):
 #   Column                     Non-Null Count  Dtype  
---  ------                     --------------  -----  
 0   id                         43977 non-null  int64  
 1   airport_ref                43977 non-null  int64  
 2   airport_ident              43977 non-null  object 
 3   length_ft                  43753 non-null  float64
 4   width_ft                   41088 non-null  float64
 5   surface                    43520 non-null  object 
 6   lighted                    43977 non-null  int64  
 7   closed                     43977 non-null  int64  
 8   le_ident                   43793 non-null  object 
 9   le_latitude_deg            15016 non-null  float64
 10  le_longitude_deg           15000 non-null  float64
 11  le_elevation_ft            12781 non-null  float64
 12  le_heading_degT            14624 non-null  float64
 13  le_displaced_threshold_ft  2883 non-null   float64
 14  he_ident                   37332 non-null  object 
 15  he_latitude_deg            14971 non-null  float64
 16  he_longitude_deg           14973 non-null  float64
 17  he_elevation_ft            12620 non-null  float64
 18  he_heading_degT            16428 non-null  float64
 19  he_displaced_threshold_ft  3176 non-null   float64
dtypes: float64(12), int64(4), object(4)
memory usage: 6.7+ MB
```

In [12]:
```
# 'le_ident', 'le_latitude_deg','le_longitude_deg', 'le_elevation_ft', 'le_heading_deg
#        'le_displaced_threshold_ft', 'he_ident', 'he_latitude_deg','he_longitude_deg
#        'he_displaced_threshold_ft'

# These are the feautres are irrelavent in our anaylsis
```

In [13]:
```
runway.drop(['le_ident', 'le_latitude_deg','le_longitude_deg', 'le_elevation_ft', 'le_
       'le_displaced_threshold_ft', 'he_ident', 'he_latitude_deg','he_longitude_deg',
       'he_displaced_threshold_ft'], axis=1 ,inplace=True)
```

In [14]:
```
runway.head()
```

Out[14]:

	id	airport_ref	airport_ident	length_ft	width_ft	surface	lighted	closed
0	269408	6523	00A	80.0	80.0	ASPH-G	1	0
1	255155	6524	00AK	2500.0	70.0	GRVL	0	0
2	254165	6525	00AL	2300.0	200.0	TURF	0	0
3	270932	6526	00AR	40.0	40.0	GRASS	0	0
4	322128	322127	00AS	1450.0	60.0	Turf	0	0

In [15]:
```
airport.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 73805 entries, 0 to 73804
Data columns (total 18 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   id                 73805 non-null  int64  
 1   ident              73805 non-null  object 
 2   type               73805 non-null  object 
 3   name               73805 non-null  object 
 4   latitude_deg       73805 non-null  float64
 5   longitude_deg      73805 non-null  float64
 6   elevation_ft       59683 non-null  float64
 7   continent          38086 non-null  object 
 8   iso_country        73546 non-null  object 
 9   iso_region         73805 non-null  object 
 10  municipality       68739 non-null  object 
 11  scheduled_service  73805 non-null  object 
 12  gps_code           42996 non-null  object 
 13  iata_code          9160 non-null   object 
 14  local_code         32975 non-null  object 
 15  home_link          3492 non-null   object 
 16  wikipedia_link     10705 non-null  object 
 17  keywords           13951 non-null  object 
dtypes: float64(3), int64(1), object(14)
memory usage: 10.1+ MB
```

In [16]:

```
airport.drop(['continent', 'iso_country', 'iso_region','municipality', 'gps_code','loc
                          'wikipedia_link', 'keywords'], axis=1 ,inplace=True)
```

In [17]:

```
airport.head()
```

Out[17]:

	id	ident	type	name	latitude_deg	longitude_deg	elevation_ft	scheduled_service
0	6523	00A	heliport	Total Rf Heliport	40.070801	-74.933601	11.0	no
1	323361	00AA	small_airport	Aero B Ranch Airport	38.704022	-101.473911	3435.0	no
2	6524	00AK	small_airport	Lowell Field	59.947733	-151.692524	450.0	no
3	6525	00AL	small_airport	Epps Airpark	34.864799	-86.770302	820.0	no
4	6526	00AR	closed	Newport Hospital & Clinic Heliport	35.608700	-91.254898	237.0	no

- ### Now Lets Merge The Runway And Airport Data.

In [18]:

```
# As The "Ident" IN Airport Is Same As The "Airport_ident" In The Runway
```

In [19]:

```
airport_runway = pd.merge(airport, runway, left_on="ident", right_on="airport_ident")
airport_runway.drop(['id_x','id_y'], axis=1, inplace=True)
```

In [20]:
```
airport_runway
```

Out[20]:

	ident	type	name	latitude_deg	longitude_deg	elevation_ft	scheduled_ser
0	00A	heliport	Total Rf Heliport	40.070801	-74.933601	11.0	
1	00AK	small_airport	Lowell Field	59.947733	-151.692524	450.0	
2	00AL	small_airport	Epps Airpark	34.864799	-86.770302	820.0	
3	00AR	closed	Newport Hospital & Clinic Heliport	35.608700	-91.254898	237.0	
4	00AS	small_airport	Fulton Airport	34.942803	-97.818019	1100.0	
...	...	...	...	...	...	...	
43972	ZYTX	large_airport	Shenyang Taoxian International Airport	41.639801	123.483002	198.0	
43973	ZYYJ	medium_airport	Yanji Chaoyangchuan Airport	42.882801	129.451004	624.0	
43974	ZYYK	medium_airport	Yingkou Lanqi Airport	40.542524	122.358600	NaN	
43975	ZZ-0003	small_airport	Fainting Goat Airport	32.110587	-97.356312	690.0	
43976	ZZZZ	small_airport	Satsuma I≈çjima Airport	30.784722	130.270556	338.0	

43977 rows × 15 columns

In [21]:
```
# Now Lets The Final Column Airline.
final_df= pd.merge(airline,airport_runway, how="inner",left_on="AirportFrom",right_on=
```

In [22]:
```
final_df.drop_duplicates(subset=['id'], keep='first',inplace=True)
final_df.head()
```

Out[22]:

	id	Airline	Flight	AirportFrom	AirportTo	DayOfWeek	Time	Length	Delay	ident	...	elevati
0	1	CO	269	SFO	IAH	3	15	205	1	KSFO	...	
4	4	AA	2466	SFO	DFW	3	20	195	1	KSFO	...	
8	9	DL	2606	SFO	MSP	3	35	216	1	KSFO	...	
12	129	DL	1580	SFO	DTW	3	345	270	0	KSFO	...	
16	150	UA	756	SFO	DEN	3	348	158	0	KSFO	...	

5 rows × 24 columns

B. Web Scraping

- When it comes to on-time arrivals, different airlines perform differently based on the amount of experience they have. The major airlines in this field include US Airways Express (founded in 1967) Continental Airlines (founded in 1934), and Express Jet (founded in 19860. Pull such information specific to various airlines from the Wikipedia page link given below.https://en.wikipedia.org/wiki/List_of_airlines_of_the_United_States.

In [23]:

```
# Now lets use the web scrapping to import the data frome the wikipedia.
url = "https://en.wikipedia.org/wiki/List_of_airlines_of_the_United_States"
tables = pd.read_html(url)
```

In [24]:

```
print(tables)
```

```
[                Airline  Image IATA ICAO         Callsign  \
0        Alaska Airlines    NaN   AS  ASA           ALASKA
1          Allegiant Air    NaN   G4  AAY        ALLEGIANT
2      American Airlines    NaN   AA  AAL         AMERICAN
3         Avelo Airlines    NaN   XP  VXP            AVELO
4         Breeze Airways    NaN   MX  MXY             MOXY
5        Delta Air Lines    NaN   DL  DAL            DELTA
6       Eastern Airlines    NaN   2D  EAL          EASTERN
7      Frontier Airlines    NaN   F9  FFT  FRONTIER FLIGHT
8      Hawaiian Airlines    NaN   HA  HAL         HAWAIIAN
9                JetBlue    NaN   B6  JBU          JETBLUE
10   Southwest Airlines    NaN   WN  SWA        SOUTHWEST
11      Spirit Airlines    NaN   NK  NKS     SPIRIT WINGS
12  Sun Country Airlines    NaN   SY  SCX      SUN COUNTRY
13      United Airlines    NaN   UA  UAL           UNITED

                        Primary hubs, Secondary hubs  Founded  \
0   Seattle/TacomaAnchoragePortland (OR)San Franci...     1932
1   Las VegasCincinnatiFort Walton BeachIndianapol...     1997
2   Dallas/Fort WorthCharlotteChicago-O'HareLos An...     1926
3                             BurbankNew HavenOrlando     1987
4      CharlestonHartfordNew OrleansNorfolkProvoTampa     2018
5   AtlantaBostonDetroitLos AngelesMinneapolis/St....     1924
6                                    MiamiNew York-JFK     2010
7   DenverAtlantaChicago-O'HareCincinnatiCleveland...     1994
8                                      HonoluluKahului     1929
9   New York-JFKBostonLos AngelesFort LauderdaleOr...     1998
10  Dallas-LoveAtlantaBaltimoreChicago-MidwayDenve...     1967
11  Atlantic CityDetroitLas VegasFort LauderdaleCh...     1980
12     Minneapolis/St. PaulDallas/Fort WorthLas Vegas     1982
13  Chicago-O'HareDenverGuamHouston-Intercontinent...     1926

                                                Notes
0   Founded as McGee Airways and commenced operati...
1   Founded as WestJet Express and commenced opera...
2   Founded as American Airways and commenced oper...
3   First did business as Casino Express Airlines ...
4                                                 NaN
5   Founded as Huff Daland Dusters and commenced o...
6                                                 NaN
7                                                 NaN
8   Founded as Inter-Island Airways in early 1929 ...
9   Founded as New Air and commenced operations in...
10  Founded as Air Southwest and commenced operati...
11                             Founded as Charter One.
12  Commenced operations in 1983.Operates some Ama...
13  Founded as Varney Air Lines and commenced oper...  ,              Airline  Image
IATA ICAO      Callsign  \
0      Air Wisconsin    NaN   ZW  AWI     WISCONSIN
1           Cape Air    NaN   9K  KAP          CAIR
2          CommutAir    NaN   C5  UCA     COMMUTAIR
3    Contour Airlines    NaN   LF  VTE     VOLUNTEER
4       Elite Airways    NaN   7Q  MNU        MAINER
5        Endeavor Air    NaN   9E  EDV      ENDEAVOR
6          Envoy Air    NaN   MQ  ENY         ENVOY
7      GoJet Airlines    NaN   G7  GJS     LINDBERGH
8         Horizon Air    NaN   QX  QXE       HORIZON
9       Mesa Airlines    NaN   YV  ASH   AIR SHUTTLE
10  Piedmont Airlines    NaN   PT  PDT      PIEDMONT
11       PSA Airlines    NaN   OH  JIA   BLUE STREAK
```

```
12   Republic Airways    NaN   YX  RPA     BRICKYARD
13     Silver Airways    NaN   3M  SIL  SILVER WINGS
14   SkyWest Airlines    NaN   OO  SKW       SKYWEST

                         Primary Hubs, Secondary Hubs  Founded  \
0   AppletonChicago-O'HareColumbiaMilwaukeeWashing...     1965
1   HyannisBillingsBostonNantucketSt. LouisSan Jua...     1988
2                        DenverNewarkWashington-Dulles     1989
3                                         Smyrna (TN)     1982
4             Melbourne/OrlandoNewarkPortland (Maine)     2006
5   Minneapolis/St. PaulAtlanta CincinnatiDetroitN...     1985
6               Dallas/Fort WorthChicago-O'Hare Miami     1984
7                               Chicago-O'HareDenver     2004
8                        Seattle/TacomaPortland (OR)     1981
9   As American Eagle:Phoenix-Sky HarborDallas/For...     1980
10          CharlottePhiladelphiaWashington-National     1961
11          CharlottePhiladelphiaWashington-National     1979
12  As American Eagle:IndianapolisColumbus (OH)Kan...     1998
13                       Fort LauderdaleOrlandoTampa     2011
14  As Delta Connection:AtlantaBoiseColorado Sprin...     1972

                                                Notes
0                          Operates as United Express
1                                                 NaN
2                         Operates as United Express.
3                                                 NaN
4                       Commenced operations in 2014.
5   Founded as Express Airlines I. Operates as Del...
6   Founded as American Eagle Airlines. Operates a...
7   Commenced operations in 2005. Operates as Unit...
8                        Operates as Alaska Airlines.
9   Founded as Mesa Air Shuttle. All but one aircr...
10  Founded as Henson Aviation and commenced opera...
11  Founded as Vee Neal Airlines. Operates as Amer...
12  Commenced operations in 2005. Operates as Amer...
13                                                NaN
14  Operates as Delta Connection, United Express, ...  ,                              Air
line  Image IATA ICAO      Callsign  \
0                    Advanced Air    NaN   AN  WSN      WINGSPAN
1                    Air Sunshine    NaN   YI  RSI  AIR SUNSHINE
2                      Bering Air    NaN   8E  BRG    BERING AIR
3                    Boutique Air    NaN   4B  BTQ      BOUTIQUE
4                      Everts Air    NaN   5V  VTS        EVERTS
5                         Gem Air    NaN  NaN  NaN           NaN
6          Grand Canyon Airlines    NaN   YR  CVU   CANYON VIEW
7   Grand Canyon Scenic Airlines    NaN   YR  SCE        SCENIC
8                  Grant Aviation    NaN   GV  GUN          HOOT
9        Griffing Flying Service    NaN  NaN  NaN           NaN
10                 Island Airways    NaN  NaN  NaN           NaN
11                            JSX    NaN   XE  JSX     BIGSTRIPE
12                    Kenmore Air    NaN   M5  KEN       KENMORE
13                   Key Lime Air    NaN   KG  LYM      KEY LIME
14              Mokulele Airlines    NaN   MW  MHO        MAHALO
15           New England Airlines    NaN   EJ  NEA   NEW ENGLAND
16           Penobscot Island Air    NaN  NaN  NaN           NaN
17                   Reliant Air    NaN  NaN  RLI       RELIANT
18             San Juan Airlines    NaN  NaN  NaN      SKYFERRY
19                   Servant Air    NaN   8D  NaN           NaN
20       Southern Airways Express    NaN   9X  FDY      FRIENDLY
21                      Surf Air    NaN  NaN   UF       SURFAIR
```

```
22                 Taquan Air    NaN   K3  TQN        TAQUAN
23          Tradewind Aviation    NaN   TJ  GPD     GOODSPEED
24        Ultimate Air Shuttle    NaN   UE  UJC      ULTIMATE
25               Utah Airways    NaN  NaN  NaN           NaN
26      Warbelow's Air Ventures    NaN   4W  WAV      WARBELOW
27         Wright Air Service    NaN   8V  WRF  WRIGHT FLYER

                         Primary Hubs, Secondary Hubs  Founded  \
0                                           Hawthorne     2005
1                                            San Juan     1982
2                               NomeKotzebueUnalakleet     1979
3           Dallas/Fort WorthDenverPhoenix-Sky Harbor     2007
4                                   FairbanksAnchorage     1978
5                                              Salmon     2014
6                        Boulder CityGrand CanyonPage     1927
7                                        Grand Canyon     1967
8   AnchorageBethelCold BayDillinghamEmmonakKenaiK...     1971
9                                        Port Clinton     1937
10                                         Charlevoix     1945
11     BurbankOaklandLas VegasSanta AnaPhoenixConcord     2016
12            KenmoreSeattle-Lake UnionSeattle-Boeing     1946
13  Denver-CentennialDenverDenver-Rocky MountainGr...     1997
14                                  Kailua-KonaKahului     1994
15                                           Westerly     1970
16                                           Rockland     2004
17                                            Danbury     1988
18                                         Bellingham     2002
19                                             Kodiak     2003
20          MemphisDestinPittsburghWashington-Dulles     2013
21     HawthorneOaklandSan CarlosSanta BarbaraTruckee     2012
22                                    Ketchikan Harbor     1977
23                     Oxford (CT)San Juan White Plains     2001
24                                   Cincinnati-Lunken     2009
25                                              Ogden     2015
26                                          Fairbanks     1958
27                                          Fairbanks     1966

                                                Notes
0   Has the EAS contract to serve Grant County Air...
1                                                 NaN
2                                                 NaN
3                                                 NaN
4                 Founded as Tatonduk Flying Service.
5                                                 NaN
6                          Founded as Scenic Airways.
7                         Founded as Scenic Airlines.
8                      Founded as Delta Air Services.
9                                                 NaN
10              Founded as McPhillips Flying Service.
11                                                NaN
12                   Founded as Mines Collins Munro.
13                 Operates as Denver Air Connection.
14                Founded as Mokulele Flight Service.
15                                                NaN
16                                                NaN
17                                                NaN
18                                                NaN
19                                                NaN
20                                                NaN
21                                                NaN
```

```
22                                           NaN
23                                           NaN
24                                           NaN
25                                           NaN
26                                           NaN
27                                           NaN  ,
Airline  Image IATA ICAO        Callsign  \
0                  Air Charter Bahamas    NaN  NaN  NaN             NaN
1                  Air Flight Charters    NaN  NaN  FLL             NaN
2                             Airshare    NaN  NaN  XSR        AIRSHARE
3                       Berry Aviation    NaN  NaN  BYA           BERRY
4                      Bighorn Airways    NaN  NaN  BHR     BIGHORN AIR
5               Charter Air Transport    NaN   VC  SRY        STINGRAY
6                       Choice Airways    NaN  NaN  CSX      CHOICE AIR
7                            ExcelAire    NaN  NaN  XLS       EXCELAIRE
8             Global Crossing Airlines    NaN   G6  GXA          GEMINI
9                      Great Lakes Air    NaN  NaN  NaN             NaN
10                    Gryphon Airlines    NaN   Y3  VOS             NaN
11                       IAero Airways    NaN   WQ  SWQ     SWIFTFLIGHT
12                         IBC Airways    NaN   II  CSQ         CHASQUI
13  L-3 Flight International Aviation    NaN  NaN  RTD         RIPTIDE
14             Liberty Jet Management    NaN  NaN  LRT     LIBERTY JET
15                             NetJets    NaN   1I  EJA         EXECJET
16             Omni Air International    NaN   X9  OAE    OMNI-EXPRESS
17                 Omni Air Transport    NaN  NaN  DRL         DRILLER
18                  Pacific Coast Jet    NaN  NaN  PXT      PACK COAST
19                  Pentastar Aviation    NaN  NaN  DCX           TANGO
20                         Phoenix Air    NaN  NaN  PHA       GRAY BIRD
21                          PlaneSense    NaN  NaN  CNS         CHRONOS
22               Presidential Airways    NaN  NaN  PRD    PRESIDENTIAL
23             Sierra Pacific Airlines    NaN   SI  SPA  SIERRA PACIFIC
24                              Skymax    NaN  NaN  SMX          SKYMAX
25                    Songbird Airways    NaN   SK  SGB        SONGBIRD
26                   Stampede Aviation    NaN  NaN  NaN             NaN
27                Superior Air Charter    NaN  NaN  RSP       REDSTRIPE
28                  Superior Aviation    NaN   SO  HKA       SPEND AIR
29                  Talkeetna Air Taxi    NaN  NaN  NaN             NaN
30               Tropic Ocean Airways    NaN  NaN  NaN             NaN
31            World Atlantic Airlines    NaN   K8  WAL  WORLD ATLANTIC
32                 XOJET Aviation LLC    NaN  NaN  XOJ           XOJET

   Primary Hubs, Secondary Hubs  Founded  \
0                           NaN      NaN
1              Fort Lauderdale   1987.0
2                           NaN   2000.0
3                   San Marcos   1983.0
4                     Sheridan   1947.0
5           Cleveland-Lakefront   1997.0
6     Fort Lauderdale-Executive   2009.0
7              Long Island/Islip   1993.0
8   Atlantic CityLas VegasMiami   2019.0
9                   St. Ignace      NaN
10                          NaN      NaN
11                        Miami   1997.0
12              Fort Lauderdale   1991.0
13                 Newport News   1972.0
14             Long Island/Islip   2006.0
15                     Columbus   1964.0
16                        Tulsa   1993.0
17                        Tulsa      NaN
```

```
18                      NaN   2006.0
19                Waterford   1964.0
20             Cartersville   1978.0
21          Portsmouth (NH)   1992.0
22        Melbourne/Orlando      NaN
23                   Tucson   1970.0
24          Fort Lauderdale   1997.0
25                    Miami   1990.0
26          Healy/Denali NP   2011.0
27                      NaN   2006.0
28                  Lansing   1979.0
29                Talkeetna   1947.0
30          Fort Lauderdale   2009.0
31                    Miami   2002.0
32     Sacramento-McClellan   2006.0

                                                Notes
0                                                 NaN
1                                                 NaN
2                  Founded as Executive Flight Services
3                                                 NaN
4                                                 NaN
5                                                 NaN
6                                                 NaN
7                                                 NaN
8                                                 NaN
9                                                 NaN
10                                                NaN
11                               Founded as Swift Air
12                                                NaN
13                                                NaN
14                                                NaN
15                 Founded as Executive Jets Aviation.
16                                                NaN
17                                                NaN
18                                                NaN
19             Founded as Chrysler Air Transportation.
20                                                NaN
21                                                NaN
22                                                NaN
23                      Commenced operations in 1971.
24                      Commenced operations in 2013.
25                                                NaN
26                                                NaN
27                                                NaN
28                                                NaN
29                 Founded as Talkeetna Flying Service.
30                                                NaN
31  Founded as Caribbean Sun Airlines and commence...
32                                                NaN  ,                          Airl
ine  Image IATA  ICAO        Callsign  \
0                       21 Air    NaN   2I   CSB      CARGO SOUTH
1                      ABX Air    NaN   GB   ABX             ABEX
2           Air Cargo Carriers    NaN   2Q   SNC      NIGHT CARGO
3               AirNet Express    NaN  NaN   USC       STAR CHECK
4   Air Transport International    NaN   8C   ATN    AIR TRANSPORT
5        Alaska Central Express    NaN   KO   AER          ACE AIR
6              Aloha Air Cargo    NaN   KH   AAH            ALOHA
7            Alpine Air Express    NaN   5A   AIP       ALPINE AIR
8                   Amazon Air    NaN  AFW  KAFW       AMAZON AIR
```

```
9                  Ameriflight    NaN   A8   AMF         AMFLIGHT
10      Amerijet International    NaN   M6   AJT         AMERIJET
11       Ameristar Jet Charter    NaN   7Z   AJI        AMERISTAR
12       Asia Pacific Airlines    NaN   P9   MGE         MAGELLAN
13                   Atlas Air    NaN   5Y   GTI            GIANT
14            Bemidji Airlines    NaN   CH   BMJ          BEMIDJI
15             Castle Aviation    NaN  NaN   CSJ           CASTLE
16               Corporate Air    NaN  NaN   CPT          AIRSPUR
17                     CSA Air    NaN  NaN   IRO         IRON AIR
18             Empire Airlines    NaN   EM   CFS           EMPIRE
19            Everts Air Cargo    NaN   5V   VTS           EVERTS
20               FedEx Express    NaN   FX   FDX            FEDEX
21     Freight Runners Express    NaN  NaN   FRG  FREIGHT RUNNERS
22                   IFL Group    NaN   IF   IFL           EIFFEL
23                 Kalitta Air    NaN   K4   CKS           CONNIE
24            Kalitta Charters    NaN   CB   KFS          KALITTA
25            Lynden Air Cargo    NaN   L2   LYC           LYNDEN
26                  Martinaire    NaN  NaN   MRA           MARTEX
27              Merlin Airways    NaN  NaN   MEI           AVALON
28          Mountain Air Cargo    NaN   C2   MTN         MOUNTAIN
29           National Airlines    NaN   N8   NCR   NATIONAL CARGO
30          Northern Air Cargo    NaN   NC   NAC            YUKON
31             Polar Air Cargo    NaN   PO   PAC            POLAR
32           Royal Air Freight    NaN  NaN   RAX        AIR ROYAL
33           Ryan Air Services    NaN   7S   RYA         RYAN AIR
34             Sky Lease Cargo    NaN   GG   KYE         SKY CUBE
35          Skyway Enterprises    NaN   KI   SKZ       SKYWAY-INC
36                   Strat Air    NaN  NaN   NaN              NaN
37             Tepper Aviation    NaN  NaN   NaN              NaN
38    Trans Executive Airlines    NaN   KH   MUI  RHOADES EXPRESS
39                UPS Airlines    NaN   5X   UPS              UPS
40            USA Jet Airlines    NaN   UJ   JUS          JET USA
41                    West Air    NaN  NaN   PCM       PAC VALLEY
42     Western Global Airlines    NaN   KD   WGN   WESTERN GLOBAL
43             Wiggins Airways    NaN   WG   WIG  WIGGINS AIRWAYS

                          Primary Hubs, Secondary Hubs  Founded  \
0                                                Miami   2014.0
1                      Wilmington (OH)CincinnatiMiami   1980.0
2                                MilwaukeeCincinnati   1986.0
3                                Columbus-Rickenbacker   1974.0
4                           Wilmington (OH)Cincinnati   1978.0
5                                            Anchorage   1996.0
6                                             Honolulu   1946.0
7                            ProvoBillingsSioux Falls   1971.0
8   Fort Worth/AllianceCincinnatiLeipzig/HalleSan ...   2015.0
9                                    Dallas/Fort Worth   1968.0
10                                  MiamiPort of Spain   1974.0
11                  Dallas-AddisonEl PasoWillow Run   2000.0
12                                        GuamHonolulu   1998.0
13  New York-JFKAnchorageCincinnatiHoustonHuntsvil...   1992.0
14                        BemidjiMinneapolis/St. Paul   1946.0
15                                        Akron/Canton   1986.0
16                                            Billings   1981.0
17                                       Iron Mountain   1998.0
18                              Coeur d' AleneSpokane   1977.0
19                                  FairbanksAnchorage   1995.0
20  MemphisAnchorageCologne/BonnDubaiFort WorthGre...   1971.0
21                                           Milwaukee   1985.0
22                                       WaterfordMiami   1983.0
```

```
23  YpsilantiAnchorageBahrainCincinnatiHong KongNe...   1967.0
24                                          Ypsilanti      NaN
25                                          Anchorage   1995.0
26                                            Addison   1978.0
27                            BillingsMiamiSan Juan   1983.0
28                                            Kinston   1974.0
29                                    Orlando/Sanford   1985.0
30                                     AnchorageMiami   1956.0
31  AnchorageCincinnatiHong KongHonoluluLos Angele...   1993.0
32                                          Waterford   1961.0
33  AnchorageAniakBethelEmmonakKotzebueNomeSt. Mar...   1953.0
34                                              Miami   1969.0
35                                                NaN   1981.0
36                                              Miami   2018.0
37                                          Crestview   1987.0
38                                           Honolulu   1982.0
39  LouisvilleChicago/RockfordCologne/BonnColumbia...   1988.0
40                                     YpsilantiLaredo   1994.0
41        Las VegasOaklandOntarioSacramentoSan Diego   1988.0
42     Miami Liege, Belgium; AnchorageFort Myers, FL   2013.0
43                                         Manchester   1929.0

                                                Notes
0                                                 NaN
1   Founded as Airborne Express. Operates some Ama...
2                       Commenced operations in 1980.
3                   Founded as Financial Air Express.
4   Founded as US Airways and commenced operations...
5                                                 NaN
6   Founded as Trans-Pacific Airlines and separate...
7                                                 NaN
8                           Formerly Amazon Prime Air
9                  Founded as California Air Charter.
10                                                NaN
11                                                NaN
12                                                NaN
13  Commenced operations in 1993. Operates some Am...
14                      Commenced operations in 1947.
15                                                NaN
16                                                NaN
17                                                NaN
18                                                NaN
19                                                NaN
20  Founded as Federal Express and commenced opera...
21                                                NaN
22                     Founded as Air Contract Cargo.
23         Founded as American International Airways.
24                                                NaN
25                                                NaN
26                                                NaN
27                                                NaN
28                                                NaN
29                      Commenced operations in 1986.
30                                                NaN
31                                                NaN
32                                                NaN
33                    Founded as Unalakleet Air Taxi.
34  Founded as Wrangler Aviation and commenced ope...
35                      Commenced operations in 1983.
36                                                NaN
```

```
37                                                  NaN
38                                                  NaN
39                                                  NaN
40                                                  NaN
41                                                  NaN
42                                                  NaN
43                                                  NaN  ,                 Airline  Im
age  IATA  ICAO  Callsign  \
0   AirMed International    NaN   NaN   NaN       NaN
1            Air Methods    NaN   NaN   NaN       NaN
2  Critical Air Medicine    NaN   NaN   NaN       NaN
3               Lifestar    NaN   NaN   NaN       NaN
4              Life Lion    NaN   NaN   NaN       NaN

  Primary Hubs, Secondary Hubs  Founded                            Notes
0     Birmingham-Shuttlesworth   1987.0  Founded as MEDjet International.
1            Denver-Centennial   1980.0                              NaN
2                          NaN   1984.0                              NaN
3                          NaN      NaN                              NaN
4                          NaN      NaN                              NaN  ,
Airline  Image  IATA ICAO  \
0                                              Comco    NaN   NaN  NaN
1                                              Janet    NaN   NaN  WWW
2  Justice Prisoner and Alien Transportation System    NaN   NaN  JUD

  Callsign Primary Hubs, Secondary Hubs  Founded  \
0      NaN                          NaN     2002
1    JANET                    Las Vegas     1972
2  JUSTICE                Oklahoma City     1980

                          Notes
0                           NaN
1                           NaN
2  Commenced operations in 1995.  ,                                   vteLists of airl
ines  \
0                                   By airline codes
1                                       By continent
2                                         By country
3                             vteExpand for full list
4   A Abkhazia Afghanistan Akrotiri and Dhekelia Å...
5                                                   A
6                                                   B
7                                                   C
8                                                   D
9                                                   E
10                                                  F
11                                                  G
12                                                  H
13                                                  I
14                                                  J
15                                                  K
16                                                  L
17                                                  M
18                                                  N
19                                                  O
20                                                  P
21                                                  Q
22                                                  R
23                                                  S
24                                                  T
```

```
25  U Uganda Ukraine United Arab Emirates United K...
26                                                 U
27                                                 V
28                                                 W
29                                                 Y
30                                                 Z
31                                          See also

                              vteLists of airlines.1
0   All 0-9 A B C D E F G H I J K L M N O P Q R S ...
1                 Africa Americas Asia Europe Oceania
2   vteExpand for full listA Abkhazia Afghanistan ...
3                              vteExpand for full list
4   A Abkhazia Afghanistan Akrotiri and Dhekelia Å...
5   Abkhazia Afghanistan Akrotiri and Dhekelia Åla...
6   The Bahamas Bahrain Bangladesh Barbados Belaru...
7   Cambodia Cameroon Canada Cape Verde Cayman Isl...
8   Denmark Dhekelia Djibouti Dominica Dominican R...
9   East Timor Ecuador Egypt El Salvador Equatoria...
10  Falkland Islands Faroe Islands Fiji Finland Fr...
11  Gabon The Gambia Georgia Germany Ghana Gibralt...
12                    Haiti Honduras Hong Kong Hungary
13  Iceland India Indonesia Iran Iraq Ireland Isra...
14                         Jamaica Japan Jersey Jordan
15  Kazakhstan Kenya Kiribati North Korea South Ko...
16  Laos Latvia Lebanon Lesotho Liberia Libya Liec...
17  Macau Macedonia, Republic of Madagascar Malawi...
18  Namibia Nauru Nepal Netherlands Netherlands An...
19                                                Oman
20  Pakistan Palau Palestine Panama Papua New Guin...
21                                               Qatar
22                               Romania Russia Rwanda
23  Sahrawi Arab Democratic Republic Saint Barthél...
24  Taiwan Tajikistan Tanzania Thailand Togo Tokel...
25  U Uganda Ukraine United Arab Emirates United K...
26  Uganda Ukraine United Arab Emirates United Kin...
27  Vanuatu Vatican City Venezuela Vietnam British...
28                                   Wallis and Futuna
29                                               Yemen
30                                     Zambia Zimbabwe
31  List of airline holding companies List of airl...  ,
vteExpand for full list  \
0   A Abkhazia Afghanistan Akrotiri and Dhekelia Å...
1                                                 A
2                                                 B
3                                                 C
4                                                 D
5                                                 E
6                                                 F
7                                                 G
8                                                 H
9                                                 I
10                                                J
11                                                K
12                                                L
13                                                M
14                                                N
15                                                O
16                                                P
17                                                Q
```

```
18                                                   R
19                                                   S
20                                                   T
21  U Uganda Ukraine United Arab Emirates United K...
22                                                   U
23                                                   V
24                                                   W
25                                                   Y
26                                                   Z

                              vteExpand for full list.1
0   A Abkhazia Afghanistan Akrotiri and Dhekelia Å...
1   Abkhazia Afghanistan Akrotiri and Dhekelia Åla...
2   The Bahamas Bahrain Bangladesh Barbados Belaru...
3   Cambodia Cameroon Canada Cape Verde Cayman Isl...
4   Denmark Dhekelia Djibouti Dominica Dominican R...
5   East Timor Ecuador Egypt El Salvador Equatoria...
6   Falkland Islands Faroe Islands Fiji Finland Fr...
7   Gabon The Gambia Georgia Germany Ghana Gibralt...
8                       Haiti Honduras Hong Kong Hungary
9   Iceland India Indonesia Iran Iraq Ireland Isra...
10                           Jamaica Japan Jersey Jordan
11  Kazakhstan Kenya Kiribati North Korea South Ko...
12  Laos Latvia Lebanon Lesotho Liberia Libya Liec...
13  Macau Macedonia, Republic of Madagascar Malawi...
14  Namibia Nauru Nepal Netherlands Netherlands An...
15                                                Oman
16  Pakistan Palau Palestine Panama Papua New Guin...
17                                               Qatar
18                                Romania Russia Rwanda
19  Sahrawi Arab Democratic Republic Saint Barthél...
20  Taiwan Tajikistan Tanzania Thailand Togo Tokel...
21  U Uganda Ukraine United Arab Emirates United K...
22  Uganda Ukraine United Arab Emirates United Kin...
23  Vanuatu Vatican City Venezuela Vietnam British...
24                                     Wallis and Futuna
25                                               Yemen
26                                     Zambia Zimbabwe  ,     0
1
0   A  Abkhazia Afghanistan Akrotiri and Dhekelia Åla...
1   B  The Bahamas Bahrain Bangladesh Barbados Belaru...
2   C  Cambodia Cameroon Canada Cape Verde Cayman Isl...
3   D  Denmark Dhekelia Djibouti Dominica Dominican R...
4   E  East Timor Ecuador Egypt El Salvador Equatoria...
5   F  Falkland Islands Faroe Islands Fiji Finland Fr...
6   G  Gabon The Gambia Georgia Germany Ghana Gibralt...
7   H                   Haiti Honduras Hong Kong Hungary
8   I  Iceland India Indonesia Iran Iraq Ireland Isra...
9   J                        Jamaica Japan Jersey Jordan
10  K  Kazakhstan Kenya Kiribati North Korea South Ko...
11  L  Laos Latvia Lebanon Lesotho Liberia Libya Liec...
12  M  Macau Macedonia, Republic of Madagascar Malawi...
13  N  Namibia Nauru Nepal Netherlands Netherlands An...
14  O                                             Oman
15  P  Pakistan Palau Palestine Panama Papua New Guin...
16  Q                                            Qatar
17  R                             Romania Russia Rwanda
18  S  Sahrawi Arab Democratic Republic Saint Barthél...
19  T  Taiwan Tajikistan Tanzania Thailand Togo Tokel...,    0
1
```

```
0  U  Uganda Ukraine United Arab Emirates United Kin...
1  V  Vanuatu Vatican City Venezuela Vietnam British...
2  W                                Wallis and Futuna
3  Y                                            Yemen
4  Z                                  Zambia Zimbabwe,                     vteAirli
nes of the United States  \
0                                            Mainline
1                                            Regional
2                                          Affiliated
3                                         Independent
4                                               Cargo
5                                             Charter
6                                   Air taxi and tours
7                                        Air ambulance
8                                          Government
9  List of airline holding companies List of airl...

                  vteAirlines of the United States.1
0  Alaska Airlines Allegiant Air American Airline...
1  Affiliated Air Wisconsin CommutAir Endeavor Ai...
2  Air Wisconsin CommutAir Endeavor Air Envoy Air...
3  Advanced Air Air Flamenco Air Sunshine Bering ...
4  ABX Air Air Cargo Carriers Air Transport Inter...
5  Air Charter Bahamas Airstream Jets Alerion Avi...
6  Gem Air Grand Canyon Scenic Airlines Griffing ...
7  Air Evac Lifeteam AirMed International Air Met...
8                  Comco Janet JPATS Patriot Express
9  List of airline holding companies List of airl...  ,             0
1
0   Affiliated  Air Wisconsin CommutAir Endeavor Air Envoy Air...
1  Independent  Advanced Air Air Flamenco Air Sunshine Bering ...,                 v
teList of airlines of the Americas  \
0  North America Caribbean Central America Northe...
1                                   Sovereign states
2                  Dependencies andother territories

               vteList of airlines of the Americas.1  \
0  North America Caribbean Central America Northe...
1  Antigua and Barbuda Argentina Bahamas Barbados...
2  Anguilla Aruba Bermuda Bonaire British Virgin ...

               vteList of airlines of the Americas.2
0  North America Caribbean Central America Northe...
1                                                NaN
2                                                NaN  ,
0                      1
0  Authority control: National libraries  Israel United States]
```

In [25]:
```
tables[0]
```

Out[25]:

	Airline	Image	IATA	ICAO	Callsign	Primary hubs, Secondary hubs	Founded	No
0	Alaska Airlines	NaN	AS	ASA	ALASKA	Seattle/TacomaAnchoragePortland (OR)San Franci...	1932	Founde Mc Airways commen opera
1	Allegiant Air	NaN	G4	AAY	ALLEGIANT	Las VegasCincinnatiFort Walton BeachIndianapol...	1997	Founde Wes Express commen ope
2	American Airlines	NaN	AA	AAL	AMERICAN	Dallas/Fort WorthCharlotteChicago-O'HareLos An...	1926	Founde Ameri Airways commen op
3	Avelo Airlines	NaN	XP	VXP	AVELO	BurbankNew HavenOrlando	1987	First busines Ca Exp Airline
4	Breeze Airways	NaN	MX	MXY	MOXY	CharlestonHartfordNew OrleansNorfolkProvoTampa	2018	N
5	Delta Air Lines	NaN	DL	DAL	DELTA	AtlantaBostonDetroitLos AngelesMinneapolis/St....	1924	Founde Huff Dal Dusters commen
6	Eastern Airlines	NaN	2D	EAL	EASTERN	MiamiNew York-JFK	2010	N
7	Frontier Airlines	NaN	F9	FFT	FRONTIER FLIGHT	DenverAtlantaChicago-O'HareCincinnatiCleveland...	1994	N
8	Hawaiian Airlines	NaN	HA	HAL	HAWAIIAN	HonoluluKahului	1929	Founde Inter-Isl Airway early 192
9	JetBlue	NaN	B6	JBU	JETBLUE	New York-JFKBostonLos AngelesFort LauderdaleOr...	1998	Founde New Air commen operati
10	Southwest Airlines	NaN	WN	SWA	SOUTHWEST	Dallas-LoveAtlantaBaltimoreChicago-MidwayDenve...	1967	Founde Air Southw commen opera
11	Spirit Airlines	NaN	NK	NKS	SPIRIT WINGS	Atlantic CityDetroitLas VegasFort LauderdaleCh...	1980	Founde Charter C
12	Sun Country Airlines	NaN	SY	SCX	SUN COUNTRY	Minneapolis/St. PaulDallas/Fort WorthLas Vegas	1982	Commen operation

	Airline	Image	IATA	ICAO	Callsign	Primary hubs, Secondary hubs	Founded	No
								1983.Opera some Ar
13	United Airlines	NaN	UA	UAL	UNITED	Chicago-O'HareDenverGuamHouston-Intercontinent...	1926	Founde Varney Lines commen

In [26]:
```
tables[6]
```

Out[26]:

	Airline	Image	IATA	ICAO	Callsign	Primary Hubs, Secondary Hubs	Founded	Notes
0	Comco	NaN	NaN	NaN	NaN	NaN	2002	NaN
1	Janet	NaN	NaN	WWW	JANET	Las Vegas	1972	NaN
2	Justice Prisoner and Alien Transportation System	NaN	NaN	JUD	JUSTICE	Oklahoma City	1980	Commenced operations in 1995.

In [27]:
```
# Lets First Merge All Wikipedia Table.
wiki_table= [tables[0],tables[1],tables[2],tables[3],tables[4],tables[5],tables[6]]
```

In [28]:
```
wiki_tables=pd.concat(wiki_table, ignore_index=True)
```

In [29]:
```
wiki_tables.head()
```

Out[29]:

	Airline	Image	IATA	ICAO	Callsign	Primary hubs, Secondary hubs	Founded	Notes
0	Alaska Airlines	NaN	AS	ASA	ALASKA	Seattle/TacomaAnchoragePortland (OR)San Franci...	1932.0	Founded as McGee Airways and commenced operati...
1	Allegiant Air	NaN	G4	AAY	ALLEGIANT	Las VegasCincinnatiFort Walton BeachIndianapol...	1997.0	Founded as WestJet Express and commenced opera...
2	American Airlines	NaN	AA	AAL	AMERICAN	Dallas/Fort WorthCharlotteChicago-O'HareLos An...	1926.0	Founded as American Airways and commenced oper...
3	Avelo Airlines	NaN	XP	VXP	AVELO	BurbankNew HavenOrlando	1987.0	First did business as Casino Express Airlines ...
4	Breeze Airways	NaN	MX	MXY	MOXY	CharlestonHartfordNew OrleansNorfolkProvoTampa	2018.0	NaN

c. You should then get all the information gathered so far in one place.

In [30]:
```
# First we got only that column from wiki pedia table that we need to merge.
wiki_df = wiki_tables[['IATA', "Founded"]]
wiki_df
```

Out[30]:

	IATA	Founded
0	AS	1932.0
1	G4	1997.0
2	AA	1926.0
3	XP	1987.0
4	MX	2018.0
...	...	...
137	NaN	NaN
138	NaN	NaN
139	NaN	2002.0
140	NaN	1972.0
141	NaN	1980.0

142 rows × 2 columns

In [31]:

```
# Now we gather all the information that we got from wiki pedia link and the data that
df = final_df.merge(wiki_df, left_on ='Airline', right_on = "IATA")
df
```

Out[31]:

	id	Airline	Flight	AirportFrom	AirportTo	DayOfWeek	Time	Length	Delay	ident	...
0	4	AA	2466	SFO	DFW	3	20	195	1	KSFO	...
1	231	AA	526	SFO	DFW	3	360	215	0	KSFO	...
2	234	AA	552	SFO	MIA	3	360	315	1	KSFO	...
3	905	AA	810	SFO	ORD	3	385	255	0	KSFO	...
4	1739	AA	24	SFO	JFK	3	425	325	1	KSFO	...
...	...	...	...	...	...	...	...	...	...	...	...
434919	497838	9E	4292	LWB	JFK	3	890	110	1	KLWB	...
434920	516333	9E	4292	LWB	JFK	4	890	110	0	KLWB	...
434921	534123	9E	4292	LWB	JFK	5	890	110	0	KLWB	...
434922	69058	9E	3752	ABR	MSP	7	410	76	1	KABR	...
434923	189396	9E	3752	ABR	MSP	7	410	76	0	KABR	...

434924 rows × 26 columns

d. The total passenger traffic may also contribute to flight delays.

- The term hub refers to busy commercial airports. Large hubs are airports that account for at least 1 percent of the total passenger enplanements in the United States. Airports that account for 0.25 percent to 1 percent of total passenger enplanements are considered medium hubs. Pull passenger traffic data from the Wikipedia page given below using web scraping and collate it in a table.
https://en.wikipedia.org/wiki/List_of_the_busiest_airports_in_the_United_States

In [32]:
```
# Now lets use the web scrapping to import the data frome the wikipedia.
url2 = "https://en.wikipedia.org/wiki/List_of_the_busiest_airports_in_the_United_State
table = pd.read_html(url2)
```

In [33]:
```
table[0]
```

Out[33]:

	Rank(2021)	Airports (large hubs)	IATACode	Major cities served	State	2021[3]	2020[4]	2019[5]
0	1	Hartsfield–Jackson Atlanta International Airport	ATL	Atlanta	GA	36676010	20559866	53505795
1	2	Dallas/Fort Worth International Airport	DFW	Dallas & Ft. Worth	TX	30005266	18593421	35778573
2	3	Denver International Airport	DEN	Denver	CO	28645527	16243216	33592945
3	4	O'Hare International Airport	ORD	Chicago	IL	26350976	14606034	40871223
4	5	Los Angeles International Airport	LAX	Los Angeles	CA	23663410	14055777	42939104
5	6	Charlotte Douglas International Airport	CLT	Charlotte	NC	20900875	12952869	24199688
6	7	Orlando International Airport	MCO	Orlando	FL	19618838	10467728	24562271
7	8	Harry Reid International Airport	LAS	Las Vegas	NV	19160342	10584059	24728361
8	9	Phoenix Sky Harbor International Airport	PHX	Phoenix	AZ	18940287	10531436	22433552
9	10	Miami International Airport	MIA	Miami	FL	17500096	8786007	21421031
10	11	Seattle–Tacoma International Airport	SEA	Seattle	WA	17430195	9462411	25001762
11	12	George Bush Intercontinental Airport	IAH	Houston	TX	16242821	8682558	21905309
12	13	John F. Kennedy International Airport	JFK	New York City	NY	15273342	8269819	31036655
13	14	Newark Liberty International Airport	EWR	Newark & New York City	NJ	14514049	7985474	23160763
14	15	Fort Lauderdale–Hollywood International Airport	FLL	Fort Lauderdale	FL	13598994	8015744	17950989
15	16	Minneapolis–Saint Paul International Airport	MSP	Minneapolis & Saint Paul	MN	12211409	7069720	19192917
16	17	San Francisco International Airport	SFO	San Francisco	CA	11725347	7745057	27779230
17	18	Detroit Metropolitan Airport	DTW	Detroit	MI	11517696	6822324	18143040
18	19	Logan International Airport	BOS	Boston	MA	10909817	6035452	20699377

	Rank(2021)	Airports (large hubs)	IATACode	Major cities served	State	2021[3]	2020[4]	2019[5]
19	20	Salt Lake City International Airport	SLC	Salt Lake City	UT	10795906	5753239	12840841
20	21	Philadelphia International Airport	PHL	Philadelphia	PA	9820222	5753239	16006389
21	22	Baltimore/Washington International Airport	BWI	Baltimore & Washington, D.C.	MD	9253561	5451355	13284687
22	23	Tampa International Airport	TPA	Tampa	FL	8847197	4966775	10978756
23	24	San Diego International Airport	SAN	San Diego	CA	7836360	4637856	12648692
24	25	LaGuardia Airport	LGA	New York City	NY	7827307	4147116	15393601
25	26	Midway International Airport	MDW	Chicago	IL	7680617	4236603	10081781
26	27	Nashville International Airport	BNA	Nashville	TN	7594049	4013995	8935654
27	28	Washington Dulles International Airport	IAD	Washington, D.C.	VA	7227875	3862658	11884117
28	29	Ronald Reagan Washington National Airport	DCA	Washington, D.C.	VA	6731737	3573489	11595454
29	30	Austin–Bergstrom International Airport	AUS	Austin	TX	6666215	3141505	8683711

In [34]:
```
table[0] = table[0].drop(['2021[3]','2013[11]','2012[12]'],axis=1)
```

In [35]:
```
table[0].head()
```

Out[35]:

	Rank(2021)	Airports (large hubs)	IATACode	Major cities served	State	2020[4]	2019[5]	2018[6]	2017[7]	20
0	1	Hartsfield–Jackson Atlanta International Airport	ATL	Atlanta	GA	20559866	53505795	51865797	50251964	505
1	2	Dallas/Fort Worth International Airport	DFW	Dallas & Ft. Worth	TX	18593421	35778573	32821799	31816933	312
2	3	Denver International Airport	DEN	Denver	CO	16243216	33592945	31362941	29809097	282
3	4	O'Hare International Airport	ORD	Chicago	IL	14606034	40871223	39873927	38593028	375
4	5	Los Angeles International Airport	LAX	Los Angeles	CA	14055777	42939104	42624050	41232432	396

In [36]:
```
table[0]['traffic_Chg19_20'] = table[0]['2020[4]'] - table[0]['2019[5]']
```

In [37]:
```
table[0]['traffic_Chg18_19'] = table[0]['2019[5]'] - table[0]['2018[6]']
table[0]['hubs']=str('large_hub')
```

In [38]:
```
table[0]=table[0][['IATACode','traffic_Chg19_20','traffic_Chg18_19','hubs']]
table[0].head()
```

Out[38]:

	IATACode	traffic_Chg19_20	traffic_Chg18_19	hubs
0	ATL	-32945929	1639998	large_hub
1	DFW	-17185152	2956774	large_hub
2	DEN	-17349729	2230004	large_hub
3	ORD	-26265189	997296	large_hub
4	LAX	-28883327	315054	large_hub

In [39]:
```
table[1].head()
```

Out[39]:

	Rank(2021)	Airports (medium hubs)	IATACode	City served	State	2021[3]	2020[4]	2019[5]	2018[6]	2017[7
0	31	Dallas Love Field	DAL	Dallas	TX	6487563	3669930	8408457	8134848	787676
1	32	Daniel K. Inouye International Airport	HNL	Honolulu	HI	5830928	3126391	9988678	9578505	974398
2	33	Portland International Airport	PDX	Portland	OR	5759879	3455877	9797408	9940866	943547
3	34	William P. Hobby Airport	HOU	Houston	TX	5560780	3127178	7069614	6937061	674187
4	35	Southwest Florida International Airport	RSW	Fort Myers	FL	5080805	2947139	5144467	4719568	446130

In [40]:
```
table[1]['traffic_Chg19_20'] = table[1]['2020[4]'] - table[1]['2019[5]']
table[1]['traffic_Chg18_19'] = table[1]['2019[5]'] - table[1]['2018[6]']
table[1]['hubs'] = str('Medium_hub')
```

In [41]:
```
table[1]=table[1][['IATACode','traffic_Chg19_20','traffic_Chg18_19','hubs']]
table[1].head()
```

Out[41]:

	IATACode	traffic_Chg19_20	traffic_Chg18_19	hubs
0	DAL	-4738527	273609	Medium_hub
1	HNL	-6862287	410173	Medium_hub
2	PDX	-6341531	-143458	Medium_hub
3	HOU	-3942436	132553	Medium_hub
4	RSW	-2197328	424899	Medium_hub

In [42]:
```
# Lets Merge All Wikipedia Table.
wiki_data=[table[0],table[1]]
```

In [43]:
```
wiki_data=pd.concat(wiki_data,ignore_index= True)
```

In [44]:
```
wiki_data
```

Out[44]:

	IATACode	traffic_Chg19_20	traffic_Chg18_19	hubs
0	ATL	-32945929	1639998	large_hub
1	DFW	-17185152	2956774	large_hub
2	DEN	-17349729	2230004	large_hub
3	ORD	-26265189	997296	large_hub
4	LAX	-28883327	315054	large_hub
...	...	...	...	...
60	BOI	-1066509	114569	Medium_hub
61	MEM	-1302461	105359	Medium_hub
62	RNO	-1185313	113334	Medium_hub
63	ABQ	-1772528	-5819	Medium_hub
64	ORF	-1105982	144833	Medium_hub

65 rows × 4 columns

In [45]:
```
# Now We Gather The Information That we Got From Wikipedia Link And The Data That We H
final_df = df.merge(wiki_data, left_on='iata_code', right_on='IATACode')
final_df.head()
```

Out[45]:

	id	Airline	Flight	AirportFrom	AirportTo	DayOfWeek	Time	Length	Delay	ident	...	width_
0	4	AA	2466	SFO	DFW	3	20	195	1	KSFO	...	20C
1	231	AA	526	SFO	DFW	3	360	215	0	KSFO	...	20C
2	234	AA	552	SFO	MIA	3	360	315	1	KSFO	...	20C
3	905	AA	810	SFO	ORD	3	385	255	0	KSFO	...	20C
4	1739	AA	24	SFO	JFK	3	425	325	1	KSFO	...	20C

5 rows × 30 columns

2.You should then examine the missing values in each field, perform missing value treatment, and justify your actions.

In [46]:
```
# Now We Have The Final Data So Lets Examine The Data And Remove The Unnecessary Data
final_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 364277 entries, 0 to 364276
Data columns (total 30 columns):
 #   Column             Non-Null Count   Dtype  
---  ------             --------------   -----  
 0   id                 364277 non-null  int64  
 1   Airline            364277 non-null  object 
 2   Flight             364277 non-null  int64  
 3   AirportFrom        364277 non-null  object 
 4   AirportTo          364277 non-null  object 
 5   DayOfWeek          364277 non-null  int64  
 6   Time               364277 non-null  int64  
 7   Length             364277 non-null  int64  
 8   Delay              364277 non-null  int64  
 9   ident              364277 non-null  object 
 10  type               364277 non-null  object 
 11  name               364277 non-null  object 
 12  latitude_deg       364277 non-null  float64
 13  longitude_deg      364277 non-null  float64
 14  elevation_ft       364277 non-null  float64
 15  scheduled_service  364277 non-null  object 
 16  iata_code          364277 non-null  object 
 17  airport_ref        364277 non-null  int64  
 18  airport_ident      364277 non-null  object 
 19  length_ft          364277 non-null  float64
 20  width_ft           364277 non-null  float64
 21  surface            364277 non-null  object 
 22  lighted            364277 non-null  int64  
 23  closed             364277 non-null  int64  
 24  IATA               364277 non-null  object 
 25  Founded            364277 non-null  float64
 26  IATACode           364277 non-null  object 
 27  traffic_Chg19_20   364277 non-null  int64  
 28  traffic_Chg18_19   364277 non-null  int64  
 29  hubs               364277 non-null  object 
dtypes: float64(6), int64(11), object(13)
memory usage: 86.2+ MB
```

In [47]:
```
final_df = final_df.drop(['id','AirportFrom','airport_ident','iata_code','AirportTo','
                          'IATA', 'IATACode','name'], axis=1)
```

In [48]:
```
# Lets Check The Missing Values Of The Final Dataset
final_df.isnull().sum()
```

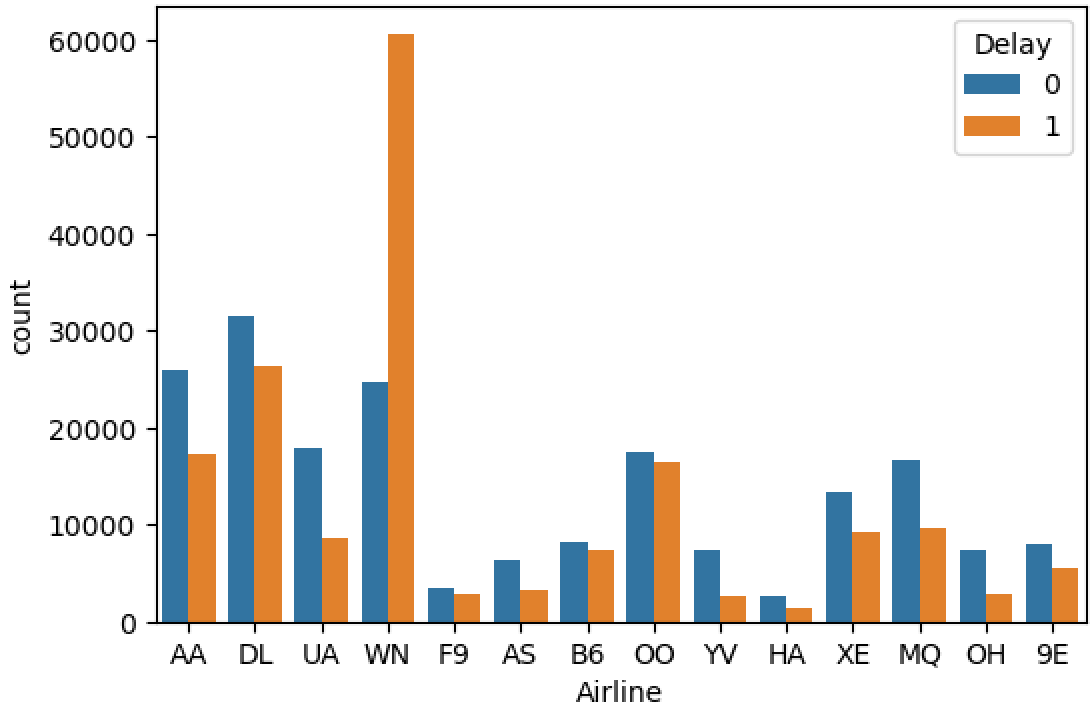
Out[48]:
```
Airline              0
Flight               0
DayOfWeek            0
Time                 0
Length               0
Delay                0
type                 0
latitude_deg         0
longitude_deg        0
elevation_ft         0
scheduled_service    0
airport_ref          0
length_ft            0
width_ft             0
lighted              0
closed               0
Founded              0
traffic_Chg19_20     0
traffic_Chg18_19     0
hubs                 0
dtype: int64
```

- No Null Data

3. Data Visualization

- ### a. According to the data provided, approximately 70% of Southwest Airlines flights are delayed. Visualize it to compare it with the data of other airlines.

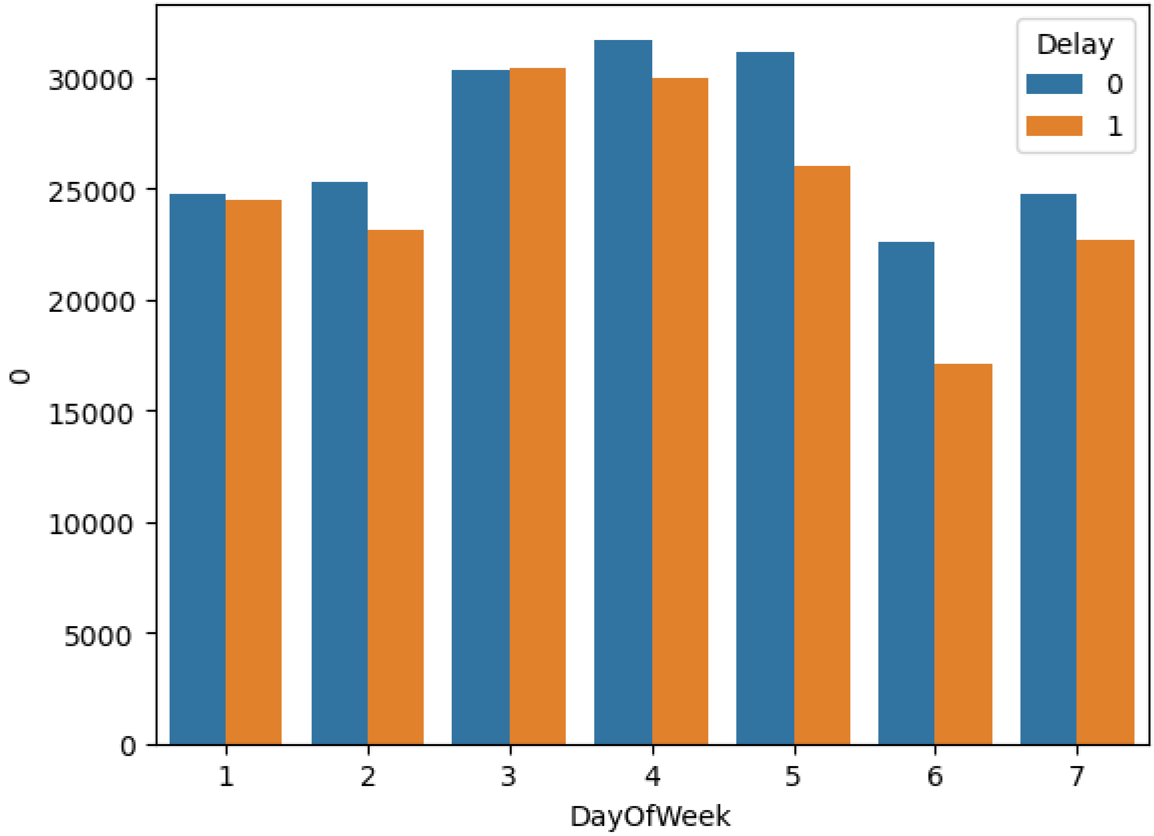
In [49]:
```
plt.figure(figsize=(6,4))
sns.countplot(final_df['Airline'], hue= final_df['Delay'])
plt.show()
```



- ### b. Flights were delayed on various weekdays. Which day of the week is the safest for travel

In [50]:
```
weekday_df = final_df[['DayOfWeek','Delay']].value_counts().reset_index()
```

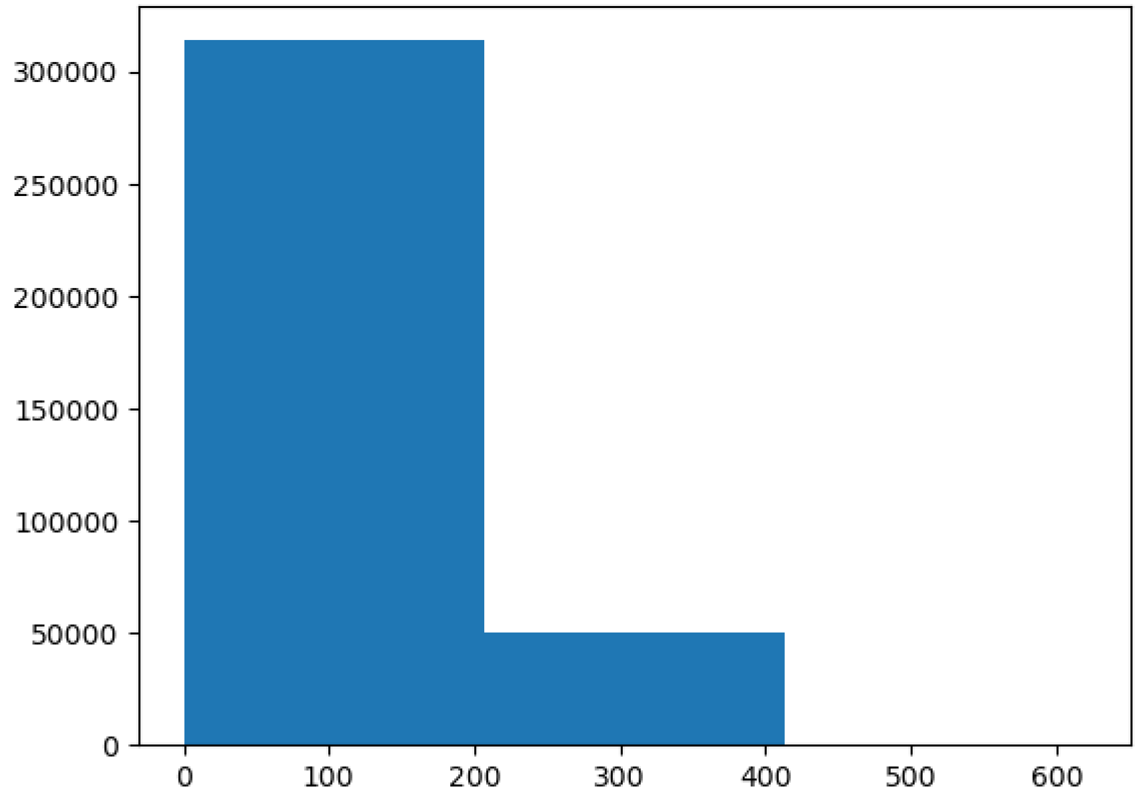
In [51]:
```
sns.barplot(weekday_df['DayOfWeek'],weekday_df[0],hue=weekday_df['Delay'])
plt.show()
```



- On The 5th And 6th Day Of The Week There Are Less No. Of Delay.

C. Airlines That Should Be Recommended For Short-, Medium-, And Long-Distance Travel

In [52]:
```
plt.hist(final_df['Length'], bins=3)
plt.show()
```



In [53]:
```
final_df['Airline'][final_df['Length']<200].value_counts()
```

Out[53]:
```
WN    75941
DL    43872
OO    32965
AA    30246
MQ    26076
XE    22114
UA    16388
9E    13573
B6    11628
OH     9963
YV     9884
AS     6350
F9     5406
HA     3034
Name: Airline, dtype: int64
```

- Airline For Short Distance Travel.

In [54]:
```
final_df['Airline'][final_df['Length']>400].value_counts()
```

Out[54]:
```
UA    549
AA    304
DL    226
B6     83
AS     31
HA     14
Name: Airline, dtype: int64
```

- Airline For Long Distance Travel

- And Remaining Are For Medium Distance Travel

D. Patterns in the departure times of long-duration flights

In [55]:
```
final_df['Time'] [final_df['Length']>400]
```

Out[55]:
```
46345     1045
46348     1045
46356     1045
46364     1045
46367     1045
          ...
315043    1416
315049    1416
315055    1416
315061    1416
315067    1416
Name: Time, Length: 1207, dtype: int64
```

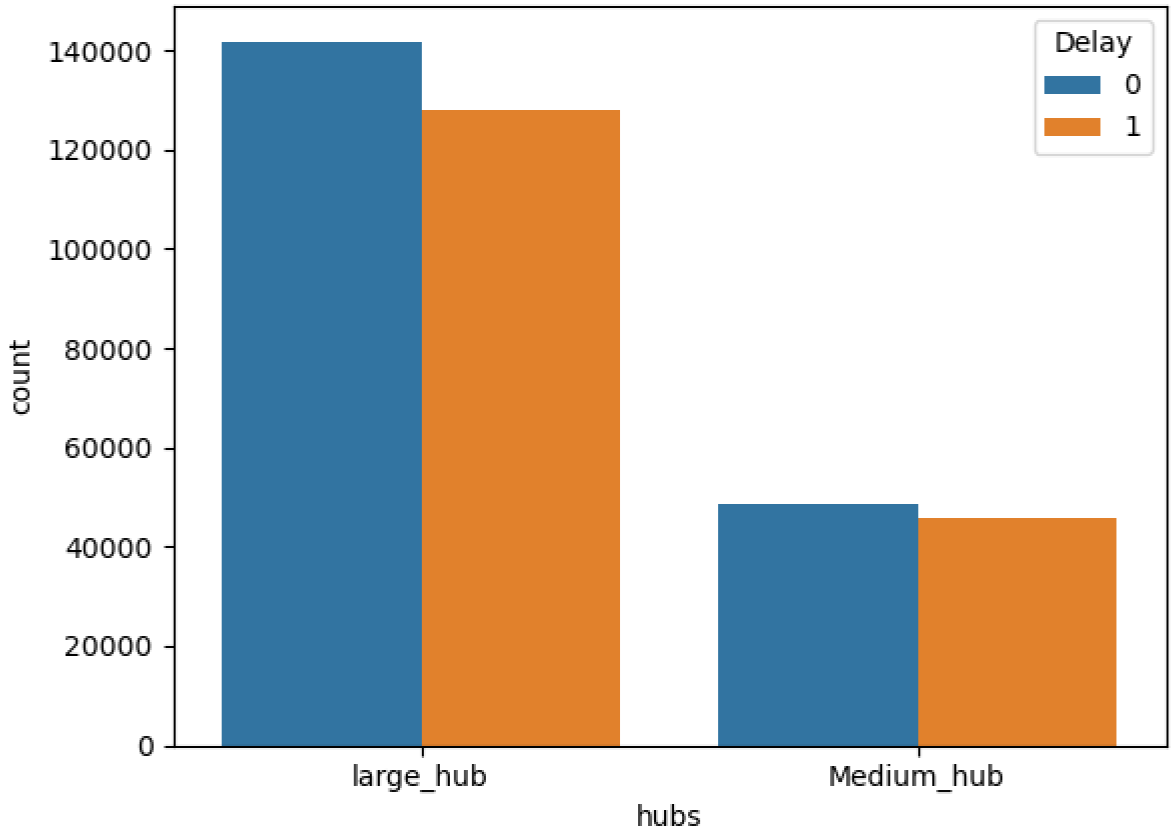
In [56]:
```
final_df['Length']>400
```

Out[56]:
```
0         False
1         False
2         False
3         False
4         False
          ...
364272    False
364273    False
364274    False
364275    False
364276    False
Name: Length, Length: 364277, dtype: bool
```

- It is clear from the above table that is only of that flight which travel a long distance and comman thing in the departure time is all long distance flight leave the airport above 1045 time.

4. visualization to represent of flights were delayed at large hubs compared to medium hubs

In [57]:
```
sns.countplot(final_df['hubs'], hue= final_df['Delay'])
plt.show()
```



5. Use hypothesis testing strategies to discover:

a. If the airport's altitude has anything to do with flight delays for incoming and departing flights

In [58]:

```
from scipy.stats import chi2_contingency
table = [final_df['latitude_deg'],final_df['Delay']]
stat, p, dof, expected = chi2_contingency(table)
print('stat=%.3f, p=%.3f' % (stat, p))
if p > 0.05:
    print('Probably independent')
else:
    print('Probably dependent')
```

```
stat=194730.438, p=1.000
Probably independent
```

b. If the number of runways at an airport affects flight delays

In [59]:

```
from scipy.stats import chi2_contingency
table = [final_df['airport_ref'],final_df['Delay']]
stat, p, dof, expected = chi2_contingency(table)
print('stat=%.3f, p=%.3f' % (stat, p))
if p > 0.05:
    print('Probably independent')
else:
    print('Probably dependent')
```

```
stat=200241.469, p=1.000
Probably independent
```

c. If the duration of a flight (length) affects flight delays

In [60]:

```
from scipy.stats import spearmanr
data1 = final_df['Length']
data2 = final_df['Delay']
stat, p = spearmanr(data1, data2)
print('stat=%.3f, p=%.3f' % (stat, p))
if p > 0.05:
    print('Probably independent')
else:
    print('Probably dependent')
```

```
stat=-0.002, p=0.203
Probably independent
```

6. Correlation Matrix

In [61]:

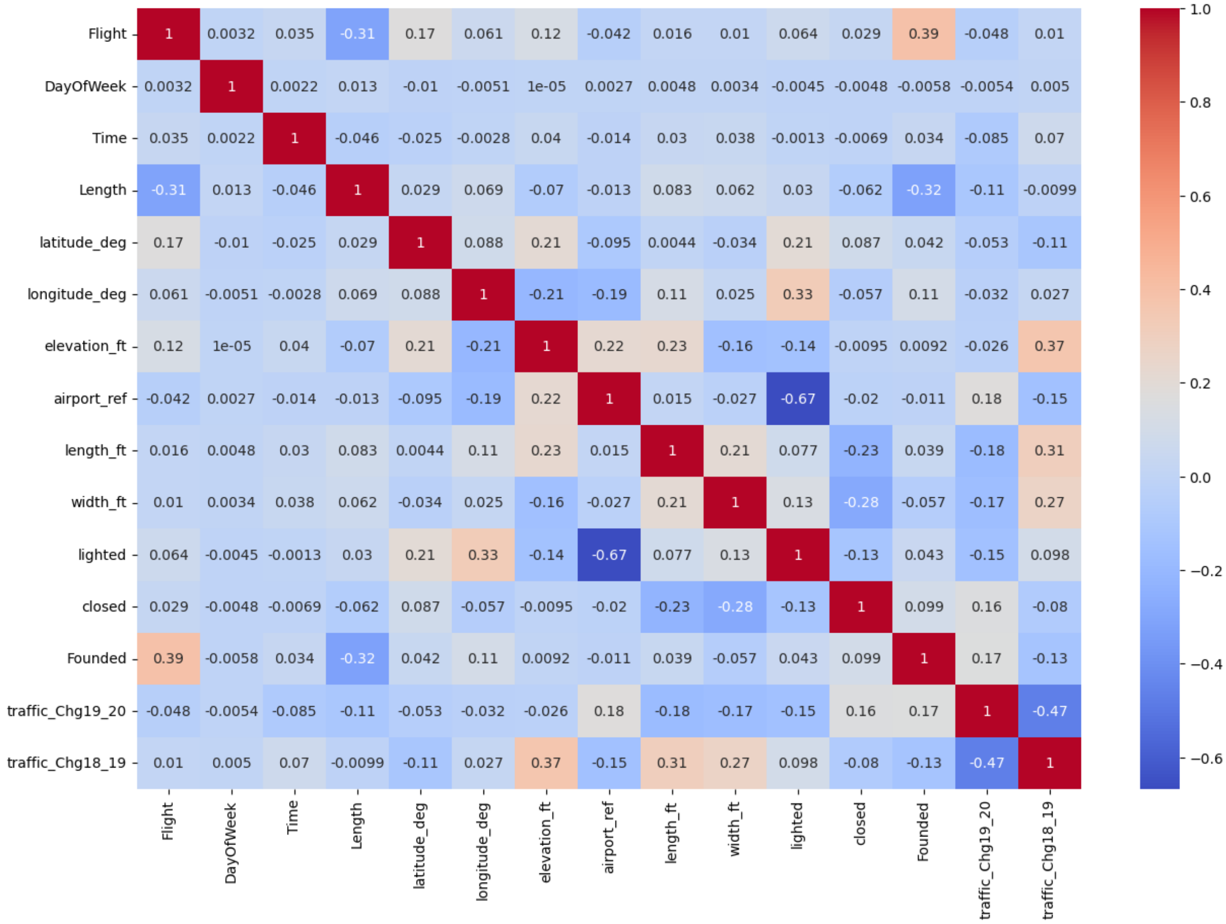
```
predictor = final_df.drop(['Delay'], axis=1)
corr= predictor.corr()
corr
```

Out[61]:

	Flight	DayOfWeek	Time	Length	latitude_deg	longitude_deg	elevation_
Flight	1.000000	0.003249	0.034959	-0.311840	0.168127	0.061268	0.12443
DayOfWeek	0.003249	1.000000	0.002218	0.013059	-0.010100	-0.005075	0.00001
Time	0.034959	0.002218	1.000000	-0.045729	-0.024743	-0.002804	0.03952
Length	-0.311840	0.013059	-0.045729	1.000000	0.028905	0.068559	-0.07018
latitude_deg	0.168127	-0.010100	-0.024743	0.028905	1.000000	0.087885	0.20823
longitude_deg	0.061268	-0.005075	-0.002804	0.068559	0.087885	1.000000	-0.20817
elevation_ft	0.124437	0.000010	0.039522	-0.070187	0.208233	-0.208175	1.00000
airport_ref	-0.042421	0.002675	-0.014048	-0.012986	-0.095324	-0.190519	0.22456
length_ft	0.016064	0.004768	0.029940	0.083335	0.004430	0.114385	0.22592
width_ft	0.010186	0.003414	0.038049	0.062138	-0.034404	0.024904	-0.15523
lighted	0.064012	-0.004520	-0.001339	0.029629	0.205215	0.325019	-0.14175
closed	0.029169	-0.004811	-0.006927	-0.062091	0.087013	-0.056677	-0.00950
Founded	0.389930	-0.005840	0.033776	-0.318902	0.042304	0.107272	0.00917
traffic_Chg19_20	-0.048014	-0.005420	-0.084557	-0.112389	-0.053065	-0.031525	-0.02618
traffic_Chg18_19	0.010379	0.005002	0.070448	-0.009942	-0.114517	0.027168	0.36667

In [62]:

```
plt.figure(figsize=(15,10))
sns.heatmap(corr, annot=True, cmap='coolwarm')
plt.show()
```



Machine Learning

- ### 1. Use OneHotEncoder and OrdinalEncoder to deal with categorical variables

In [63]:
```
# Before applying the one hot encodding or the label encoding first we check all featu
final_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 364277 entries, 0 to 364276
Data columns (total 20 columns):
 #   Column             Non-Null Count   Dtype  
---  ------             --------------   -----  
 0   Airline            364277 non-null  object 
 1   Flight             364277 non-null  int64  
 2   DayOfWeek          364277 non-null  int64  
 3   Time               364277 non-null  int64  
 4   Length             364277 non-null  int64  
 5   Delay              364277 non-null  int64  
 6   type               364277 non-null  object 
 7   latitude_deg       364277 non-null  float64
 8   longitude_deg      364277 non-null  float64
 9   elevation_ft       364277 non-null  float64
 10  scheduled_service  364277 non-null  object 
 11  airport_ref        364277 non-null  int64  
 12  length_ft          364277 non-null  float64
 13  width_ft           364277 non-null  float64
 14  lighted            364277 non-null  int64  
 15  closed             364277 non-null  int64  
 16  Founded            364277 non-null  float64
 17  traffic_Chg19_20   364277 non-null  int64  
 18  traffic_Chg18_19   364277 non-null  int64  
 19  hubs               364277 non-null  object 
dtypes: float64(6), int64(10), object(4)
memory usage: 58.4+ MB
```

In [64]:
```
final_df['Airline'].value_counts()
```

Out[64]:
```
WN    85067
DL    57720
AA    43261
OO    33843
UA    26535
MQ    26308
XE    22566
B6    15497
9E    13573
OH    10211
YV    10002
AS     9477
F9     6180
HA     4037
Name: Airline, dtype: int64
```

In [65]:
```
final_df['type'].value_counts()
```

Out[65]:
```
large_airport     342705
medium_airport     21572
Name: type, dtype: int64
```

In [66]:
```
final_df['scheduled_service'].value_counts()
```

Out[66]:
```
yes    364277
Name: scheduled_service, dtype: int64
```

In [67]:
```
final_df['hubs'].value_counts()
```

Out[67]:
```
large_hub     269953
Medium_hub     94324
Name: hubs, dtype: int64
```

In [68]:
```
final_df = final_df.drop(['scheduled_service'], axis=1)
```

In [69]:
```
# Now using the ordinal encoder.
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
```

In [70]:
```
final_df['Airline'] = le.fit_transform(final_df['Airline'])
final_df['type'] = le.fit_transform(final_df['type'])
final_df['hubs'] = le.fit_transform(final_df['hubs'])
```

In [71]:
```
final_df.head()
```

Out[71]:

	Airline	Flight	DayOfWeek	Time	Length	Delay	type	latitude_deg	longitude_deg	elevation_ft
0	1	2466	3	20	195	1	0	37.618999	-122.375	13.0
1	1	526	3	360	215	0	0	37.618999	-122.375	13.0
2	1	552	3	360	315	1	0	37.618999	-122.375	13.0
3	1	810	3	385	255	0	0	37.618999	-122.375	13.0
4	1	24	3	425	325	1	0	37.618999	-122.375	13.0

- ### 2. Perform the following model building steps:

Logistic Regression

In [72]:
```
# Lets first seperate the predictors and the output Variable.
x = final_df.drop(['Delay'], axis= 1)
y = final_df["Delay"]
```

In [73]:
```
from sklearn import preprocessing
scaler = preprocessing.MinMaxScaler()
x = scaler.fit_transform(x)
```

In [74]:
```
# First Split the data into the training and testing set before performing the further
from sklearn.model_selection import train_test_split
```

In [75]:
```
x_train, x_test, y_train, y_test = train_test_split(x, y, train_size=0.9, random_state
```

In [76]:
```
# lets apply the logistic regression with the randomsearchcv hypermeter tunning.
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression()
```

In [77]:
```
from sklearn.model_selection import RandomizedSearchCV
```

In [78]:
```
params = {"penalty": ["l1","l2"],
          'solver': ['newton-cg', 'liblinear']}
```

```
# Cross Validation
folds = 5

rscv = RandomizedSearchCV(estimator = lr,
                          param_distributions = params,
                          scoring = "accuracy",
                          verbose = 1,
                          cv= folds)

rscv.fit(x_train, y_train)
```

```
Fitting 5 folds for each of 4 candidates, totalling 20 fits
```

Out[78]:

```
RandomizedSearchCV(cv=5, estimator=LogisticRegression(),
                   param_distributions={'penalty': ['l1', 'l2'],
                                        'solver': ['newton-cg', 'liblinear']},
                   scoring='accuracy', verbose=1)
```

In [79]:

```
print(rscv.best_params_)
print(rscv.best_score_)
```

```
{'solver': 'newton-cg', 'penalty': 'l2'}
0.5950940921237212
```

In [80]:

```
lr = LogisticRegression(penalty= 'l2', solver= 'newton-cg')
lr.fit(x_train,y_train).score(x_train,y_train)
```

Out[80]:

```
0.5951215346089206
```

DecisionTreeClassifier

In [81]:

```
from sklearn.tree import DecisionTreeClassifier

dt = DecisionTreeClassifier()

params = {'criterion': ["gini", "entropy"],
          'min_samples_leaf' : [2,3,4,5,6,7,8,9],
         "max_depth": [2,3,4,5,6,7,8,9]}

rscv = RandomizedSearchCV(estimator = dt,
                              param_distributions= params,
                              scoring = "accuracy",
                              cv= 5,
                              verbose=1)
rscv.fit(x_train, y_train)
```

```
Fitting 5 folds for each of 10 candidates, totalling 50 fits
```

Out[81]:

```
RandomizedSearchCV(cv=5, estimator=DecisionTreeClassifier(),
                   param_distributions={'criterion': ['gini', 'entropy'],
                                        'max_depth': [2, 3, 4, 5, 6, 7, 8, 9],
                                        'min_samples_leaf': [2, 3, 4, 5, 6, 7,
                                                             8, 9]},
                   scoring='accuracy', verbose=1)
```

In [82]:

```
print(rscv.best_params_)
print(rscv.best_score_)
```

```
{'min_samples_leaf': 9, 'max_depth': 9, 'criterion': 'entropy'}
0.649521580649087
```

In [83]:
```
dtc = DecisionTreeClassifier(max_depth= 9, criterion= 'entropy',min_samples_leaf= 6)
dtc.fit(x_train, y_train).score(x_train, y_train)
```

Out[83]:
```
0.6552772770391248
```

In [84]:
```
dtc.score(x_test, y_test)
```

Out[84]:
```
0.6503788294718349
```

3. Use the stratified five-fold method to build and validate the models using the XGB classifier, compare all methods, and share your findings

In [87]:
```
from xgboost import XGBClassifier

# Create the parameter grid: gbm_param_grid
gbm_param_grid = {
                 'n_estimators': range(8, 20),
                 'max_depth': range(6, 10),
                 'learning_rate': [.4, .45, .5, .55, .6],
                 'colsample_bytree': [.6, .7, .8, .9, 1]
                  }

# Instantiate the regressor: gbm
gbm = XGBClassifier()

# Perform random search: grid_mse
xgb_random = RandomizedSearchCV(param_distributions=gbm_param_grid,
                                    estimator = gbm, scoring = "accuracy",
                                    verbose = 1, n_iter = 50, cv = 3)

# Fit randomized_mse to the data
xgb_random.fit(x_train, y_train)

# Print the best parameters and lowest RMSE
print("Best parameters found: ", xgb_random.best_params_)
print("Best accuracy found: ", xgb_random.best_score_)
```

```
Fitting 3 folds for each of 50 candidates, totalling 150 fits
[14:37:14] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:14] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:15] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:15] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:16] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:16] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:17] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:17] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:18] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:18] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:19] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:19] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:20] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:20] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:20] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:21] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:21] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:22] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:22] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:23] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
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'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:24] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:25] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:25] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:26] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:26] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:27] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:27] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:28] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:28] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:29] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:30] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:30] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:30] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:31] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:31] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:32] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:32] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:33] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:34] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:34] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
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'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:35] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:35] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:36] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:36] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:36] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:37] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:37] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:38] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:38] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:39] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:39] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:40] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:41] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:41] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:42] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:42] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:43] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:44] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:44] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:45] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
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'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:46] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:46] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:47] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:47] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:48] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:48] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:49] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:49] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:50] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:50] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:51] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:51] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:51] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:52] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:53] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:53] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:54] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:54] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:54] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:55] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
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'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:55] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:56] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:56] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:57] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:57] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:58] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:58] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:58] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:59] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:37:59] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:00] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:00] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:01] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:01] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:02] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:02] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:03] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:03] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:04] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:04] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
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'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:04] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:05] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:05] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:06] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:06] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:07] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:07] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:07] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:08] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:08] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:09] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:09] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:10] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:10] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:10] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:11] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:11] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:11] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:12] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:13] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
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'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:13] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:15] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:16] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:17] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:18] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:19] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:20] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:20] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:21] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:21] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:22] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:22] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:23] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:23] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:24] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:24] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:25] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:25] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:26] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:27] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
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'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:27] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:28] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:29] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:29] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:30] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:31] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:31] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:32] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:33] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:34] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
[14:38:34] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
Best parameters found:  {'n_estimators': 19, 'max_depth': 9, 'learning_rate': 0.4, 'c
olsample_bytree': 1}
Best accuracy found:  0.6623872575484445
```

- Best parameters found: {'n_estimators': 16, 'max_depth': 9, 'learning_rate': 0.4, 'colsample_bytree': 0.8}
- Best accuracy found: 0.6623964081025107

In [86]:

```
xgb = XGBClassifier(n_estimators=14, max_depth=9, learning_rate=0.45, colsample_bytree
xgb.fit(x_train,y_train).score(x_train,y_train)
```

```
[14:36:57] WARNING: ..\src\learner.cc:1115: Starting in XGBoost 1.3.0, the default ev
aluation metric used with the objective 'binary:logistic' was changed from 'error' to
'logloss'. Explicitly set eval_metric if you'd like to restore the old behavior.
```

Out[86]:

```
0.6857333711556235
```

In [88]:

```
# Now lets compare the all method.
print(lr.score(x_test, y_test))
print(dtc.score(x_test, y_test))
print(xgb.score(x_test, y_test))
```

```
0.595640715932799
0.6503788294718349
0.664955528714176
```

- As We Can See After Comparing The Accuracy Of the Diffrent Model The Best Result We Getting From The XGBclassifier.

Tableau_Dashboard Link:-

- https://public.tableau.com/app/profile/akshaydeep.chauhan/viz/UnitedStatesAirlinesAnalysis_1(publish=yes

SQL

/ *Question No1:- Determine the number of flights that are delayed on various days of the week* /

-- First calling the database to import the data. use job_readiness; -- Import the data set to perform further operation. select *from airline; select* from airports; select * from runways;

select DayOfWeek, count(Flight), Delay from airline where Delay=1 group by DayOfWeek;

/ *Question No2:- Determine the number of delayed flights for various airlines* /

select Airline, count(Flight) from airline where Delay=1 group by Airline;

/ *Question No3:- Determine how many delayed flights land at airports with at least 10 runways* /

select AirportTo, Flight, Delay from airline where Delay=1 group by AirportTo;

/ *Question No4:- Compare the number of delayed flights at airports higher than average elevation and those that are lower than average elevation for both source and destination airports* /

-- Lets first compare for the source airport select l.AirportFrom, count(l.Flight), avg(p.elevation_ft) as avg_elevation, p.elevation_ft from airline as l inner join airports as p on p.iata_code = l.AirportFrom where p.elevation_ft >1037.25 and l.Delay=1 group by l.AirportFrom;

select l.AirportFrom, count(l.Flight), avg(p.elevation_ft) as avg_elevation, p.elevation_ft from airline as l inner join airports as p on p.iata_code = l.AirportFrom where p.elevation_ft< 1037.25 and l.Delay=1 group by l.AirportFrom;

-- Lets now compare for the destination airport select l.AirportTo, count(l.Flight), avg(p.elevation_ft) as avg_elevation, p.elevation_ft from airline as l inner join airports as p on p.iata_code = l.AirportFrom where p.elevation_ft >1037.25 and l.Delay=1 group by l.AirportTo;

select l.AirportTo, count(l.Flight), avg(p.elevation_ft) as avg_elevation, p.elevation_ft from airline as l inner join airports as p on p.iata_code = l.AirportFrom where p.elevation_ft <1037.25 and l.Delay=1 group by l.AirportTo;