

Final Project Proposal STAT167

Shreya Mohan, Kalyani Mantirraju, Crystal Arevalo, Karen Alvarez, Mason Lam

2025-04-27

Installation & Packages

```
1 library(nycflights13)
2 library(tidyverse)
```

```
-- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
```

```
v dplyr      1.1.4      v readr      2.1.5
```

```
v forcats    1.0.0      v stringr    1.5.1
```

```
v ggplot2    3.5.1      v tibble     3.2.1
```

```
v lubridate  1.9.3      v tidyr      1.3.1
```

```
v purrr      1.0.2
```

```
-- Conflicts ----- tidyverse_conflicts() --
```

```
x dplyr::filter() masks stats::filter()
```

```
x dplyr::lag()     masks stats::lag()
```

```
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

Introduction

The primary goal of this research is to explore factors influencing flight delays from New City airports in 2013.

Problem Statement and Motivation

Understanding factors that contribute to flight delays is critical for informing Federal Aviation Administration (FAA) policies and guiding airlines and airports in improving operational efficiency, enhancing weather preparedness, and reducing delays through controllable factors. By analyzing weather conditions, airline differences, holiday effects, fleet age, and airport specific challenges, this research can provide data-driven insights to optimize air travel and ensure compliance with aviation regulations in heavily congested areas like New York City.

Main Research Question

What are the key correlations between flight delays from NYC airports?

Sub-questions:

The following questions will guide the analysis:

1. How do weather conditions affect flight delays?
 - a. Are specific weather variables (e.g., precipitation, wind speed, humidity) correlated with departure and arrival delays?
2. How do differences between airlines influence flight delays?
 - a. Do certain airlines experience more delays than other, if so, what operational or fleet-related factors contribute to these differences?
 - b. How do metrics like cancellation rates and plane speed vary across airlines, and what impact do these metrics have on delays?
3. Are delays more frequent during major holidays?
 - a. Are there differences during peak travel periods (e.g., Thanksgiving, Christmas, New Year's Day)
4. Does the age of the plane affect flight delays?
 - a. Do older planes experience more delays compared to newer ones?
 - b. Are there specific plane models or manufactures associated with better on-time performance?
5. How do environmental factors like humidity, visibility, and wind affect flight delays?
 - a. Are these effects observed across all airports?
6. What impact does precipitation have on specific airports and weather-related delays?
 - a. Do airports in regions with higher average precipitation experience more delays?

Datasets

1. Flights dataset: All flights that departed from NYC in 2013

```
1 head(flights)
```

```
# A tibble: 6 x 19
  year month   day dep_time sched_dep_time dep_delay arr_time sched_arr_time
  <int> <int> <int>   <int>         <int>         <dbl>   <int>         <int>
1  2013     1     1     517           515           2     830           819
2  2013     1     1     533           529           4     850           830
3  2013     1     1     542           540           2     923           850
```

```

4 2013      1      1      544          545      -1      1004          1022
5 2013      1      1      554          600      -6       812           837
6 2013      1      1      554          558      -4       740           728
# i 11 more variables: arr_delay <dbl>, carrier <chr>, flight <int>,
#   tailnum <chr>, origin <chr>, dest <chr>, air_time <dbl>, distance <dbl>,
#   hour <dbl>, minute <dbl>, time_hour <dtm>

```

```
1 dim(flights)
```

```
[1] 336776      19
```

```
1 names(flights)
```

```

[1] "year"          "month"          "day"            "dep_time"
[5] "sched_dep_time" "dep_delay"      "arr_time"       "sched_arr_time"
[9] "arr_delay"      "carrier"        "flight"         "tailnum"
[13] "origin"         "dest"           "air_time"       "distance"
[17] "hour"           "minute"         "time_hour"

```

```
1 str(flights)
```

```

tibble [336,776 x 19] (S3: tbl_df/tbl/data.frame)
 $ year      : int  [1:336776] 2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
 $ month     : int  [1:336776] 1 1 1 1 1 1 1 1 1 1 1 ...
 $ day       : int  [1:336776] 1 1 1 1 1 1 1 1 1 1 1 ...
 $ dep_time  : int  [1:336776] 517 533 542 544 554 554 555 557 557 558 ...
 $ sched_dep_time: int [1:336776] 515 529 540 545 600 558 600 600 600 600 ...
 $ dep_delay : num  [1:336776] 2 4 2 -1 -6 -4 -5 -3 -3 -2 ...
 $ arr_time  : int  [1:336776] 830 850 923 1004 812 740 913 709 838 753 ...
 $ sched_arr_time: int [1:336776] 819 830 850 1022 837 728 854 723 846 745 ...
 $ arr_delay : num  [1:336776] 11 20 33 -18 -25 12 19 -14 -8 8 ...
 $ carrier   : chr  [1:336776] "UA" "UA" "AA" "B6" ...
 $ flight    : int  [1:336776] 1545 1714 1141 725 461 1696 507 5708 79 301 ...
 $ tailnum   : chr  [1:336776] "N14228" "N24211" "N619AA" "N804JB" ...
 $ origin    : chr  [1:336776] "EWR" "LGA" "JFK" "JFK" ...
 $ dest      : chr  [1:336776] "IAH" "IAH" "MIA" "BQN" ...
 $ air_time  : num  [1:336776] 227 227 160 183 116 150 158 53 140 138 ...
 $ distance  : num  [1:336776] 1400 1416 1089 1576 762 ...
 $ hour      : num  [1:336776] 5 5 5 5 6 5 6 6 6 6 ...
 $ minute    : num  [1:336776] 15 29 40 45 0 58 0 0 0 0 ...
 $ time_hour : POSIXct[1:336776], format: "2013-01-01 05:00:00" "2013-01-01 05:00:00" ...

```

```
1 glimpse(flights)
```

```

Rows: 336,776
Columns: 19
$ year      <int> 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2~
$ month     <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1~
$ day       <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1~
$ dep_time  <int> 517, 533, 542, 544, 554, 554, 555, 557, 557, 558, 558, ~
$ sched_dep_time <int> 515, 529, 540, 545, 600, 558, 600, 600, 600, 600, 600, ~
$ dep_delay <dbl> 2, 4, 2, -1, -6, -4, -5, -3, -3, -2, -2, -2, -2, -2, -1~
$ arr_time  <int> 830, 850, 923, 1004, 812, 740, 913, 709, 838, 753, 849,~
$ sched_arr_time <int> 819, 830, 850, 1022, 837, 728, 854, 723, 846, 745, 851,~
$ arr_delay <dbl> 11, 20, 33, -18, -25, 12, 19, -14, -8, 8, -2, -3, 7, -1~
$ carrier   <chr> "UA", "UA", "AA", "B6", "DL", "UA", "B6", "EV", "B6", "~
$ flight    <int> 1545, 1714, 1141, 725, 461, 1696, 507, 5708, 79, 301, 4~
$ tailnum   <chr> "N14228", "N24211", "N619AA", "N804JB", "N668DN", "N394~
$ origin    <chr> "EWR", "LGA", "JFK", "JFK", "LGA", "EWR", "EWR", "LGA",~
$ dest      <chr> "IAH", "IAH", "MIA", "BQN", "ATL", "ORD", "FLL", "IAD",~
$ air_time  <dbl> 227, 227, 160, 183, 116, 150, 158, 53, 140, 138, 149, 1~
$ distance  <dbl> 1400, 1416, 1089, 1576, 762, 719, 1065, 229, 944, 733, ~
$ hour      <dbl> 5, 5, 5, 5, 6, 5, 6, 6, 6, 6, 6, 6, 6, 6, 5, 6, 6, 6~
$ minute    <dbl> 15, 29, 40, 45, 0, 58, 0, 0, 0, 0, 0, 0, 0, 0, 59, 0~
$ time_hour <dtm> 2013-01-01 05:00:00, 2013-01-01 05:00:00, 2013-01-01 0~

```

Variables:

- flights (year, month, day, dep_time, arr_time, sched_dep_time, sched_arr_time, dep_delay, arr_delay, carrier, origin, dest, air_time, distance, time_hour)
 - year, month, day : date of departure
 - dep_time, arr_time : actual departure and arrival times in HHMM
 - sched_dep_time, sched_arr_time : scheduled departure and arrival times in HHMM
 - dep_delay, arr_delay : departure and arrival delays in minutes
 - carrier : two letter carrier abbreviation of the carrier
 - origin, dest : origin and destination
 - air_time : amount of time spent in air in minutes
 - distance : distance between airport in miles
 - time_hour : scheduled date and hour of the flight as POSIXct date

2. Airlines dataset: Translation between two letter carrier codes and names

```
1 head(airlines)
```

```

# A tibble: 6 x 2
  carrier name
  <chr>   <chr>
1 9E      Endeavor Air Inc.
2 AA      American Airlines Inc.

```

```

3 AS      Alaska Airlines Inc.
4 B6      JetBlue Airways
5 DL      Delta Air Lines Inc.
6 EV      ExpressJet Airlines Inc.

```

```
1 dim(airlines)
```

```
[1] 16  2
```

```
1 names(airlines)
```

```
[1] "carrier" "name"
```

```
1 str(airlines)
```

```

tibble [16 x 2] (S3: tbl_df/tbl/data.frame)
 $ carrier: chr [1:16] "9E" "AA" "AS" "B6" ...
 $ name   : chr [1:16] "Endeavor Air Inc." "American Airlines Inc." "Alaska Airlines Inc." "JetBlue A

```

```
1 glimpse(airlines)
```

```

Rows: 16
Columns: 2
$ carrier <chr> "9E", "AA", "AS", "B6", "DL", "EV", "F9", "FL", "HA", "MQ", "O~
$ name      <chr> "Endeavor Air Inc.", "American Airlines Inc.", "Alaska Airline~

```

Variables:

- airlines (carrier, name)
 - carrier : two-letter abbreviation of the airlines
 - name : full name of the airlines

3. Airports dataset: Airport names and locations

```
1 head(airports)
```

```

# A tibble: 6 x 8
  faa  name                lat  lon  alt  tz dst  tzone
<chr> <chr>              <dbl> <dbl> <dbl> <dbl> <chr> <chr>
1 04G  Lansdowne Airport      41.1 -80.6 1044  -5 A   America/Ne~
2 06A  Moton Field Municipal Airport 32.5 -85.7  264  -6 A   America/Ch~
3 06C  Schaumburg Regional    42.0 -88.1  801  -6 A   America/Ch~
4 06N  Randall Airport        41.4 -74.4  523  -5 A   America/Ne~
5 09J  Jekyll Island Airport   31.1 -81.4   11  -5 A   America/Ne~
6 0A9  Elizabethton Municipal Airport 36.4 -82.2 1593  -5 A   America/Ne~

```

```
1 dim(airports)
```

```
[1] 1458    8
```

```
1 names(airports)
```

```
[1] "faa"    "name"   "lat"    "lon"    "alt"    "tz"     "dst"    "tzone"
```

```
1 str(airports)
```

```
tibble [1,458 x 8] (S3: tbl_df/tbl/data.frame)
 $ faa  : chr [1:1458] "04G" "06A" "06C" "06N" ...
 $ name : chr [1:1458] "Lansdowne Airport" "Moton Field Municipal Airport" "Schaumburg Regional" "Ran
 $ lat  : num [1:1458] 41.1 32.5 42 41.4 31.1 ...
 $ lon  : num [1:1458] -80.6 -85.7 -88.1 -74.4 -81.4 ...
 $ alt  : num [1:1458] 1044 264 801 523 11 ...
 $ tz   : num [1:1458] -5 -6 -6 -5 -5 -5 -5 -5 -5 -8 ...
 $ dst  : chr [1:1458] "A" "A" "A" "A" ...
 $ tzone: chr [1:1458] "America/New_York" "America/Chicago" "America/Chicago" "America/New_York" ...
 - attr(*, "spec")=
   .. cols(
   ..   id = col_double(),
   ..   name = col_character(),
   ..   city = col_character(),
   ..   country = col_character(),
   ..   faa = col_character(),
   ..   icao = col_character(),
   ..   lat = col_double(),
   ..   lon = col_double(),
   ..   alt = col_double(),
   ..   tz = col_double(),
   ..   dst = col_character(),
   ..   tzone = col_character()
   .. )
```

```
1 glimpse(airports)
```

```
Rows: 1,458
Columns: 8
 $ faa   <chr> "04G", "06A", "06C", "06N", "09J", "0A9", "OG6", "OG7", "OP2", "~
 $ name  <chr> "Lansdowne Airport", "Moton Field Municipal Airport", "Schaumbur~
 $ lat   <dbl> 41.13047, 32.46057, 41.98934, 41.43191, 31.07447, 36.37122, 41.4~
 $ lon   <dbl> -80.61958, -85.68003, -88.10124, -74.39156, -81.42778, -82.17342~
 $ alt   <dbl> 1044, 264, 801, 523, 11, 1593, 730, 492, 1000, 108, 409, 875, 10~
 $ tz    <dbl> -5, -6, -6, -5, -5, -5, -5, -5, -5, -5, -8, -5, -6, -5, -5, -5, ~
 $ dst   <chr> "A", "A", "A", "A", "A", "A", "A", "A", "U", "A", "A", "U", "A",~
 $ tzone <chr> "America/New_York", "America/Chicago", "America/Chicago", "Ameri~
```

Variables:

- airports (faa, name, lat, lon)
 - faa : FAA airport code
 - name : usual name of the airport
 - lat, lon : location of airport

4. Planes dataset: Construction information about each plane

```
1 head(planes)
```

```
# A tibble: 6 x 9
  tailnum year type      manufacturer model engines seats speed engine
  <chr>   <int> <chr>      <chr>         <chr>   <int> <int> <int> <chr>
1 N10156  2004 Fixed wing multi ~ EMBRAER    EMB~      2    55    NA Turbo~
2 N102UW  1998 Fixed wing multi ~ AIRBUS INDU~ A320~      2   182    NA Turbo~
3 N103US  1999 Fixed wing multi ~ AIRBUS INDU~ A320~      2   182    NA Turbo~
4 N104UW  1999 Fixed wing multi ~ AIRBUS INDU~ A320~      2   182    NA Turbo~
5 N10575  2002 Fixed wing multi ~ EMBRAER    EMB~      2    55    NA Turbo~
6 N105UW  1999 Fixed wing multi ~ AIRBUS INDU~ A320~      2   182    NA Turbo~
```

```
1 dim(planes)
```

```
[1] 3322    9
```

```
1 names(planes)
```

```
[1] "tailnum"      "year"         "type"         "manufacturer" "model"
[6] "engines"      "seats"        "speed"        "engine"
```

```
1 str(planes)
```

```
tibble [3,322 x 9] (S3: tbl_df/tbl/data.frame)
 $ tailnum      : chr [1:3322] "N10156" "N102UW" "N103US" "N104UW" ...
 $ year         : int [1:3322] 2004 1998 1999 1999 2002 1999 1999 1999 1999 1999 ...
 $ type         : chr [1:3322] "Fixed wing multi engine" "Fixed wing multi engine" "Fixed wing multi e
 $ manufacturer: chr [1:3322] "EMBRAER" "AIRBUS INDUSTRIE" "AIRBUS INDUSTRIE" "AIRBUS INDUSTRIE" ...
 $ model        : chr [1:3322] "EMB-145XR" "A320-214" "A320-214" "A320-214" ...
 $ engines       : int [1:3322] 2 2 2 2 2 2 2 2 2 2 ...
 $ seats        : int [1:3322] 55 182 182 182 55 182 182 182 182 182 ...
 $ speed        : int [1:3322] NA NA NA NA NA NA NA NA NA NA ...
 $ engine       : chr [1:3322] "Turbo-fan" "Turbo-fan" "Turbo-fan" "Turbo-fan" ...
```

```
1 glimpse(planes)
```

```
Rows: 3,322
Columns: 9
$ tailnum      <chr> "N10156", "N102UW", "N103US", "N104UW", "N10575", "N105UW~
$ year         <int> 2004, 1998, 1999, 1999, 2002, 1999, 1999, 1999, 1999, 199~
$ type         <chr> "Fixed wing multi engine", "Fixed wing multi engine", "Fi~
$ manufacturer <chr> "EMBRAER", "AIRBUS INDUSTRIE", "AIRBUS INDUSTRIE", "AIRBU~
$ model        <chr> "EMB-145XR", "A320-214", "A320-214", "A320-214", "EMB-145~
$ engines       <int> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
$ seats        <int> 55, 182, 182, 182, 55, 182, 182, 182, 182, 182, 55, 55, 5~
$ speed        <int> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
$ engine       <chr> "Turbo-fan", "Turbo-fan", "Turbo-fan", "Turbo-fan", "Turb~
```

Variables:

- planes (year, type, manufacturer, model, engines, seats, speed, engine)
 - year : year manufactured
 - type : type of plane
 - manufacturer, model : manufacturer and model
 - engines, seats : number of engines and seats
 - speed : average cruising speed in mph
 - engine : type in engine

5. Weather dataset: Hourly meterological data for each airport

```
1 head(weather)
```

```
# A tibble: 6 x 15
  origin year month   day hour temp dewp humid wind_dir wind_speed wind_gust
  <chr>   <int> <int> <int> <int> <dbl> <dbl> <dbl>   <dbl>     <dbl>     <dbl>
1 EWR    2013     1     1     1  39.0  26.1  59.4     270      10.4      NA
2 EWR    2013     1     1     2  39.0  27.0  61.6     250       8.06     NA
3 EWR    2013     1     1     3  39.0  28.0  64.4     240      11.5      NA
4 EWR    2013     1     1     4  39.9  28.0  62.2     250      12.7      NA
5 EWR    2013     1     1     5  39.0  28.0  64.4     260      12.7      NA
6 EWR    2013     1     1     6  37.9  28.0  67.2     240      11.5      NA
# i 4 more variables: precip <dbl>, pressure <dbl>, visib <dbl>,
#   time_hour <dtm>
```

```
1 dim(weather)
```

```
[1] 26115    15
```



```
1 names(weather)
```

```
[1] "origin"      "year"        "month"        "day"          "hour"
[6] "temp"        "dewp"        "humid"        "wind_dir"     "wind_speed"
[11] "wind_gust"   "precip"      "pressure"     "visib"        "time_hour"
```

```
1 str(weather)
```

```
tibble [26,115 x 15] (S3: tbl_df/tbl/data.frame)
 $ origin   : chr [1:26115] "EWR" "EWR" "EWR" "EWR" ...
 $ year     : int [1:26115] 2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
 $ month    : int [1:26115] 1 1 1 1 1 1 1 1 1 1 ...
 $ day      : int [1:26115] 1 1 1 1 1 1 1 1 1 1 ...
 $ hour     : int [1:26115] 1 2 3 4 5 6 7 8 9 10 ...
 $ temp     : num [1:26115] 39 39 39 39.9 39 ...
 $ dewp     : num [1:26115] 26.1 27 28 28 28 ...
 $ humid    : num [1:26115] 59.4 61.6 64.4 62.2 64.4 ...
 $ wind_dir : num [1:26115] 270 250 240 250 260 240 240 250 260 260 ...
 $ wind_speed: num [1:26115] 10.36 8.06 11.51 12.66 12.66 ...
 $ wind_gust : num [1:26115] NA NA NA NA NA NA NA NA NA NA ...
 $ precip   : num [1:26115] 0 0 0 0 0 0 0 0 0 0 ...
 $ pressure : num [1:26115] 1012 1012 1012 1012 1012 ...
 $ visib    : num [1:26115] 10 10 10 10 10 10 10 10 10 10 ...
 $ time_hour : POSIXct[1:26115], format: "2013-01-01 01:00:00" "2013-01-01 02:00:00" ...
```

```
1 glimpse(weather)
```

```
Rows: 26,115
Columns: 15
 $ origin   <chr> "EWR", "EWR", "EWR", "EWR", "EWR", "EWR", "EWR", "EWR", "EW~
 $ year     <int> 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2013, 2013,~
 $ month    <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
 $ day      <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
 $ hour     <int> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, ~
 $ temp     <dbl> 39.02, 39.02, 39.02, 39.92, 39.02, 37.94, 39.02, 39.92, 39.~
 $ dewp     <dbl> 26.06, 26.96, 28.04, 28.04, 28.04, 28.04, 28.04, 28.04, 28.~
 $ humid    <dbl> 59.37, 61.63, 64.43, 62.21, 64.43, 67.21, 64.43, 62.21, 62.~
 $ wind_dir <dbl> 270, 250, 240, 250, 260, 240, 240, 250, 260, 260, 260, 330,~
 $ wind_speed <dbl> 10.35702, 8.05546, 11.50780, 12.65858, 12.65858, 11.50780, ~
 $ wind_gust <dbl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, 20.~
 $ precip   <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,~
 $ pressure <dbl> 1012.0, 1012.3, 1012.5, 1012.2, 1011.9, 1012.4, 1012.2, 101~
 $ visib    <dbl> 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10,~
 $ time_hour <dtm> 2013-01-01 01:00:00, 2013-01-01 02:00:00, 2013-01-01 03:00~
```

Variables:

- weather (origin, year, month, day, hour, temp, dewp, humid, wind_dir, wind_speed, wind_gust, precip, pressure, visib, time_hour)
 - origin : weather station
 - year, month, day, hour : time of recording
 - temp, dewp : temperature and dew point in Fahrenheit
 - humid : relative humidity
 - wind_dir, wind_speed, wind_gust : wind direction in degrees, wind speed and gust in mph
 - precip : precipitation in inches
 - pressure : sea level pressure in millibars
 - visib : visibility in miles
 - time_hour : date and hour of the recording as POSIXct date

We can join the data tables by combining them through similar attributes, such as combining flights : time_hour with weather : time_hour.

EDA:

Summary Statistics & Check for Missing Values:

```
1 summary(flights)
```

year		month		day		dep_time		sched_dep_time	
Min.	:2013	Min.	: 1.000	Min.	: 1.00	Min.	: 1	Min.	: 106
1st Qu.	:2013	1st Qu.	: 4.000	1st Qu.	: 8.00	1st Qu.	: 907	1st Qu.	: 906
Median	:2013	Median	: 7.000	Median	:16.00	Median	:1401	Median	:1359
Mean	:2013	Mean	: 6.549	Mean	:15.71	Mean	:1349	Mean	:1344
3rd Qu.	:2013	3rd Qu.	:10.000	3rd Qu.	:23.00	3rd Qu.	:1744	3rd Qu.	:1729
Max.	:2013	Max.	:12.000	Max.	:31.00	Max.	:2400	Max.	:2359
						NA's	:8255		
dep_delay		arr_time		sched_arr_time		arr_delay			
Min.	: -43.00	Min.	: 1	Min.	: 1	Min.	: -86.000		
1st Qu.	: -5.00	1st Qu.	:1104	1st Qu.	:1124	1st Qu.	: -17.000		
Median	: -2.00	Median	:1535	Median	:1556	Median	: -5.000		
Mean	: 12.64	Mean	:1502	Mean	:1536	Mean	: 6.895		
3rd Qu.	: 11.00	3rd Qu.	:1940	3rd Qu.	:1945	3rd Qu.	: 14.000		
Max.	:1301.00	Max.	:2400	Max.	:2359	Max.	:1272.000		
NA's	:8255	NA's	:8713			NA's	:9430		
carrier		flight		tailnum		origin			
Length:	336776	Min.	: 1	Length:	336776	Length:	336776		
Class	:character	1st Qu.	: 553	Class	:character	Class	:character		
Mode	:character	Median	:1496	Mode	:character	Mode	:character		
		Mean	:1972						
		3rd Qu.	:3465						
		Max.	:8500						

dest	air_time	distance	hour
Length:336776	Min. : 20.0	Min. : 17	Min. : 1.00
Class :character	1st Qu.: 82.0	1st Qu.: 502	1st Qu.: 9.00
Mode :character	Median :129.0	Median : 872	Median :13.00
	Mean :150.7	Mean :1040	Mean :13.18
	3rd Qu.:192.0	3rd Qu.:1389	3rd Qu.:17.00
	Max. :695.0	Max. :4983	Max. :23.00
	NA's :9430		

minute	time_hour
Min. : 0.00	Min. :2013-01-01 05:00:00.00
1st Qu.: 8.00	1st Qu.:2013-04-04 13:00:00.00
Median :29.00	Median :2013-07-03 10:00:00.00
Mean :26.23	Mean :2013-07-03 05:22:54.64
3rd Qu.:44.00	3rd Qu.:2013-10-01 07:00:00.00
Max. :59.00	Max. :2013-12-31 23:00:00.00

```
1 colSums(is.na(flights))
```

year	month	day	dep_time	sched_dep_time
0	0	0	8255	0

dep_delay	arr_time	sched_arr_time	arr_delay	carrier
8255	8713	0	9430	0

flight	tailnum	origin	dest	air_time
0	2512	0	0	9430

distance	hour	minute	time_hour
0	0	0	0

```
1 summary(airlines)
```

carrier	name
Length:16	Length:16
Class :character	Class :character
Mode :character	Mode :character

```
1 colSums(is.na(airlines))
```

carrier	name
0	0

```
1 summary(airports)
```

faa	name	lat	lon
Length:1458	Length:1458	Min. :19.72	Min. : -176.65

Class :character	Class :character	1st Qu.:34.26	1st Qu.: -119.19
Mode :character	Mode :character	Median :40.09	Median : -94.66
		Mean :41.65	Mean : -103.39
		3rd Qu.:45.07	3rd Qu.: -82.52
		Max. :72.27	Max. : 174.11

alt	tz	dst	tzone
Min. : -54.00	Min. : -10.000	Length:1458	Length:1458
1st Qu.: 70.25	1st Qu.: -8.000	Class :character	Class :character
Median : 473.00	Median : -6.000	Mode :character	Mode :character
Mean :1001.42	Mean : -6.519		
3rd Qu.:1062.50	3rd Qu.: -5.000		
Max. :9078.00	Max. : 8.000		

```
1 colSums(is.na(airports))
```

faa	name	lat	lon	alt	tz	dst	tzone
0	0	0	0	0	0	0	3

```
1 summary(planes)
```

tailnum	year	type	manufacturer
Length:3322	Min. :1956	Length:3322	Length:3322
Class :character	1st Qu.:1997	Class :character	Class :character
Mode :character	Median :2001	Mode :character	Mode :character
	Mean :2000		
	3rd Qu.:2005		
	Max. :2013		
	NA's :70		

model	engines	seats	speed
Length:3322	Min. :1.000	Min. : 2.0	Min. : 90.0
Class :character	1st Qu.:2.000	1st Qu.:140.0	1st Qu.:107.5
Mode :character	Median :2.000	Median :149.0	Median :162.0
	Mean :1.995	Mean :154.3	Mean :236.8
	3rd Qu.:2.000	3rd Qu.:182.0	3rd Qu.:432.0
	Max. :4.000	Max. :450.0	Max. :432.0
			NA's :3299

engine
Length:3322
Class :character
Mode :character

```
1 colSums(is.na(planes))
```

```

tailnum      year      type manufacturer      model      engines
      0         70         0             0         0         0
seats        speed      engine
      0        3299         0

```

```
1 summary(weather)
```

```

origin      year      month      day
Length:26115  Min.   :2013  Min.   : 1.000  Min.   : 1.00
Class :character 1st Qu.:2013  1st Qu.: 4.000  1st Qu.: 8.00
Mode  :character Median :2013  Median : 7.000  Median :16.00
              Mean  :2013  Mean   : 6.504  Mean   :15.68
              3rd Qu.:2013  3rd Qu.: 9.000  3rd Qu.:23.00
              Max.   :2013  Max.   :12.000  Max.   :31.00

hour      temp      dewp      humid
Min.   : 0.00  Min.   : 10.94  Min.   : -9.94  Min.   : 12.74
1st Qu.: 6.00  1st Qu.: 39.92  1st Qu.:26.06  1st Qu.: 47.05
Median :11.00  Median : 55.40  Median :42.08  Median : 61.79
Mean   :11.49  Mean   : 55.26  Mean   :41.44  Mean   : 62.53
3rd Qu.:17.00  3rd Qu.: 69.98  3rd Qu.:57.92  3rd Qu.: 78.79
Max.   :23.00  Max.   :100.04  Max.   :78.08  Max.   :100.00
              NA's   :1      NA's   :1      NA's   :1

wind_dir      wind_speed      wind_gust      precip
Min.   : 0.0  Min.   : 0.000  Min.   :16.11  Min.   :0.000000
1st Qu.:120.0  1st Qu.: 6.905  1st Qu.:20.71  1st Qu.:0.000000
Median :220.0  Median : 10.357  Median :24.17  Median :0.000000
Mean   :199.8  Mean   : 10.518  Mean   :25.49  Mean   :0.004469
3rd Qu.:290.0  3rd Qu.: 13.809  3rd Qu.:28.77  3rd Qu.:0.000000
Max.   :360.0  Max.   :1048.361  Max.   :66.75  Max.   :1.210000
NA's   :460    NA's   :4      NA's   :20778

pressure      visib      time_hour
Min.   : 983.8  Min.   : 0.000  Min.   :2013-01-01 01:00:00.0
1st Qu.:1012.9  1st Qu.:10.000  1st Qu.:2013-04-01 21:30:00.0
Median :1017.6  Median :10.000  Median :2013-07-01 14:00:00.0
Mean   :1017.9  Mean   : 9.255  Mean   :2013-07-01 18:26:37.7
3rd Qu.:1023.0  3rd Qu.:10.000  3rd Qu.:2013-09-30 13:00:00.0
Max.   :1042.1  Max.   :10.000  Max.   :2013-12-30 18:00:00.0
NA's   :2729

```

```
1 colSums(is.na(weather))
```

```

origin      year      month      day      hour      temp      dewp
      0         0         0         0         0         1         1

```

humid	wind_dir	wind_speed	wind_gust	precip	pressure	visib
1	460	4	20778	0	2729	0
time_hour						
0						

Analysis Approach Plan:

Assumptions: All variables are independent

The process of analysis will involve data cleaning after forming our question, basic exploration of the data, comparison of certain datasets with other datasets, visualization of the data, and an interpretation of the data/results. Cleaning of the data will deal with tasks like handling empty cells/columns and NA values. When it comes to exploratory data analysis, we plan on using tools such as histograms and boxplots to gain an understanding of the data and identify patterns and relationships. The statistical analysis that we plan on performing with the data will most likely involve making comparisons between groups to compare airlines, times, and other metrics to make our overall claim. For example, we might be comparing trends in time performance by weeks or month between different airlines to gain a better understanding of how differences in airlines affect delays. In terms of data visualization, we will most likely be using line graphs for trends over time when it comes to comparing flight time under different variables and heatmaps/scatterplots for flight delays to help communicate our findings. Finally, interpretation of the data will involve us answering the proposed question by summarizing our statistics/findings as well as through the presentation of graphical evidence.

Alternative Strategies & Back Up Plan:

As a backup idea, we are planning on seeing if there is any correlation between the amount of delays present in the different airports. Our data deals with the airports EWR, JFK, and LGA which are all different airports within New York City. Our first question is to figure out if the JFK airport has a different amount of delays compared to LGA or EWR if there is a higher amount of precipitation in the JFK area. Although all the airports are in New York, within the different areas of the city, there can be different amounts of precipitation and rainfall that occur. Our second question is to decide whether the different airports have different models of planes and if the difference affects the amounts of delays. For example if a plane is older or a different configuration, does that lead to more delays due to cleaning or maintenance? And lastly, our third question is whether the three different airports have different airlines coming in and out and if these differing airlines affect the amount of delays present on a given day. For example, if Delta services one airport and not another, does that increase or decrease the amount of total delays for an airport. These questions can be further investigated if our first set of questions are not approved or if we need more content to explore within our project. These sets of backup questions will further explore the flight data we have.