Project NYC Fligh Analysis

Assessment Business Question by JOI

```
# note key functions

#shift + enter ==> RUN CODE
#ctrl + M ==> convert to markdown cell
```

https://bookdown.org/asmundhreinn/r4ds-master/diagrams/relational-nycflights.png

Diagram

https://bookdown.org/asmundhreinn/r4ds-master/relational-data.html

```
# check data
library(dplyr)
library(tidyverse)
```

```
Attaching package: ‘dplyr’


The following objects are masked from ‘package:stats’:

    filter, lag


The following objects are masked from ‘package:base’:

    intersect, setdiff, setequal, union


Warning message in system("timedatectl", intern = TRUE):
```

```
“running command 'timedatectl' had status 1”
Warning message:
“Failed to locate timezone database”
── Attaching packages ─────────────────────────────────────── tidyverse 1.3.1
```

```
flights <- read_csv("flights.csv")
```

```
Rows: 336776 Columns: 19

── Column specification ────────────────────────────────────────────────────────
Delimiter: ","
chr   (4): carrier, tailnum, origin, dest
dbl  (14): year, month, day, dep_time, sched_dep_time, dep_delay, arr_time, ...
dttm  (1): time_hour


ℹ Use `spec()` to retrieve the full column specification for this data.
ℹ Specify the column types or set `show_col_types = FALSE` to quiet this messag
```

```
flights <- read.csv("flights.csv")
airlines <- read.csv("airlines.csv")
planes <- read.csv("planes.csv")
weather <- read.csv("weather.csv")
```

```
# check data
head(flights)
tail(flights)
glimpse(flights)
```

```
Rows: 336,776
Columns: 19
$ year           <int> 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
$ day            <int> 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      <int> 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      <int> 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       <int> 227, 227, 160, 183, 116, 150, 158, 53, 140, 138, 149, 1
$ distance       <int> 1400, 1416, 1089, 1576, 762, 719, 1065, 229, 944, 733,
$ hour           <int> 5, 5, 5, 5, 6, 5, 6, 6, 6, 6, 6, 6, 6, 6, 5, 6, 6, 6
```

A data.frame: 6 × 19

	year	month	day	dep_time	sched_dep_time	dep_delay	arr_time	sched_arr_time	arr_delay	carrier	flight
	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<chr>	<int>
1	2013	1	1	517	515	2	830	819	11	UA	1545
2	2013	1	1	533	529	4	850	830	20	UA	1714
3	2013	1	1	542	540	2	923	850	33	AA	1141
4	2013	1	1	544	545	-1	1004	1022	-18	B6	725
5	2013	1	1	554	600	-6	812	837	-25	DL	461
6	2013	1	1	554	558	-4	740	728	12	UA	1696

A data.frame: 6 × 19

	year	month	day	dep_time	sched_dep_time	dep_delay	arr_time	sched_arr_time	arr_delay	carrier
	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<chr>
336771	2013	9	30	NA	1842	NA	NA	2019	NA	EV
336772	2013	9	30	NA	1455	NA	NA	1634	NA	9E
336773	2013	9	30	NA	2200	NA	NA	2312	NA	9E
336774	2013	9	30	NA	1210	NA	NA	1330	NA	MQ
336775	2013	9	30	NA	1159	NA	NA	1344	NA	MQ
336776	2013	9	30	NA	840	NA	NA	1020	NA	MQ

```
apply(flights , MARGIN = 2, function(col) sum(is.na(col)))
```

year: 0 month: 0 day: 0 dep_time: 8255 sched_dep_time: 0 dep_delay: 8255 arr_time: 8713 sched_arr_time: 0 arr_delay: 9430 carrier: 0 flight: 0 tailnum: 2512 origin: 0 dest: 0 air_time: 9430 distance: 0 hour: 0 minute: 0 time_hour: 0

```
glimpse(flights)
glimpse(airlines)
glimpse(planes)
glimpse(weather)
tibble()
```

```
Rows: 336,776
Columns: 19
$ year           <int> 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
$ day            <int> 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      <int> 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      <int> 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       <int> 227, 227, 160, 183, 116, 150, 158, 53, 140, 138, 149, 1
$ distance       <int> 1400, 1416, 1089, 1576, 762, 719, 1065, 229, 944, 733,
$ hour           <int> 5, 5, 5, 5, 6, 5, 6, 6, 6, 6, 6, 6, 6, 6, 6, 5, 6, 6, 6
$ minute         <int> 15, 29, 40, 45, 0, 58, 0, 0, 0, 0, 0, 0, 0, 0, 59, 0
```

%lt;0 x 0 matrix%gt;

```
# head data
head(flights)
head(airlines)
head(planes)
head(weather)
```

A data.frame: 6 × 19

	year	month	day	dep_time	sched_dep_time	dep_delay	arr_time	sched_arr_time	arr_delay	carrier	flight
	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<int>	<chr>	<int>
1	2013	1	1	517	515	2	830	819	11	UA	1545
2	2013	1	1	533	529	4	850	830	20	UA	1714
3	2013	1	1	542	540	2	923	850	33	AA	1141
4	2013	1	1	544	545	-1	1004	1022	-18	B6	725
5	2013	1	1	554	600	-6	812	837	-25	DL	461
6	2013	1	1	554	558	-4	740	728	12	UA	1696

A data.frame: 6 × 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.

A data.frame: 6 × 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 engine	EMBRAER	EMB-145XR	2	55	NA	Turbo-fan
2	N102UW	1998	Fixed wing multi engine	AIRBUS INDUSTRIE	A320-214	2	182	NA	Turbo-fan
3	N103US	1999	Fixed wing multi engine	AIRBUS INDUSTRIE	A320-214	2	182	NA	Turbo-fan
4	N104UW	1999	Fixed wing multi engine	AIRBUS INDUSTRIE	A320-214	2	182	NA	Turbo-fan
5	N10575	2002	Fixed wing multi engine	EMBRAER	EMB-145LR	2	55	NA	Turbo-fan
6	N105UW	1999	Fixed wing multi engine	AIRBUS INDUSTRIE	A320-214	2	182	NA	Turbo-fan

A data.frame: 6 × 15

	origin	year	month	day	hour	temp	dewp	humid	wind_dir	wind_speed	wind_gust	precip	pressure	v
	<chr>	<int>	<int>	<int>	<int>	<dbl>	<dbl>	<dbl>	<int>	<dbl>	<dbl>	<dbl>	<dbl>	
1	EWR	2013	1	1	1	39.02	26.06	59.37	270	10.35702	NA	0	1012.0	1
2	EWR	2013	1	1	2	39.02	26.96	61.63	250	8.05546	NA	0	1012.3	1
3	EWR	2013	1	1	3	39.02	28.04	64.43	240	11.50780	NA	0	1012.5	1

3	EWR	2013	1	1	3	39.02	28.04	64.43	240	11.50780	NA	0	1012.3
4	EWR	2013	1	1	4	39.92	28.04	62.21	250	12.65858	NA	0	1012.2
5	EWR	2013	1	1	5	39.02	28.04	64.43	260	12.65858	NA	0	1011.9
6	EWR	2013	1	1	6	37.94	28.04	67.21	240	11.50780	NA	0	1012.4

Homework Create Business Question

Which top 5 airline had total longest flight distance in March 2013?

```
flights %>%
  filter(month == 3, year == 2013) %>%
  count(carrier) %>%
  arrange(desc(n)) %>%
  left_join(airlines , "carrier") %>%
  head(5)
  tibble()
```

A data.frame: 5 × 3

	carrier	n	name
	<chr>	<int>	<chr>
1	UA	4971	United Air Lines Inc.
2	B6	4772	JetBlue Airways
3	EV	4726	ExpressJet Airlines Inc.
4	DL	4189	Delta Air Lines Inc.
5	AA	2787	American Airlines Inc.

```
%lt;0 x 0 matrix%gt;
```

What the fastest flights from NYC flights 2013 ?

```
flights %>%
    group_by(carrier) %>%
    summarise( max_distance = max(distance),
    min_distance = min(distance),
    mean_distance = mean(distance),
    sum_distance = sum(distance) ) %>%
    left_join(airlines , "carrier") %>%
    arrange(carrier)
    tibble()
```

A tibble: 16 × 6

carrier	max_distance	min_distance	mean_distance	sum_distance	name
<chr>	<int>	<int>	<dbl>	<int>	<chr>
9E	1587	94	530.2358	9788152	Endeavor Air Inc.
AA	2586	187	1340.2360	43864584	American Airlines Inc.
AS	2402	2402	2402.0000	1715028	Alaska Airlines Inc.
B6	2586	173	1068.6215	58384137	JetBlue Airways
DL	2586	94	1236.9012	59507317	Delta Air Lines Inc.
EV	1389	80	562.9917	30498951	ExpressJet Airlines Inc.
F9	1620	1620	1620.0000	1109700	Frontier Airlines Inc.
FL	762	397	664.8294	2167344	AirTran Airways Corporation
HA	4983	4983	4983.0000	1704186	Hawaiian Airlines Inc.
MQ	1147	184	569.5327	15033955	Envoy Air
OO	1008	229	500.8125	16026	SkyWest Airlines Inc.
UA	4963	116	1529.1149	89705524	United Air Lines Inc.
US	2153	17	553.4563	11365778	US Airways Inc.
VX	2586	2248	2499.4822	12902327	Virgin America
WN	2133	169	996.2691	12229203	Southwest Airlines Co.
YV	544	96	375.0333	225395	Mesa Airlines Inc.

%lt;0 x 0 matrix%gt;

Top 3 route busy on promotion in Newyear by Southwest Airlines

```
flights %>%
  select(month, day, carrier, origin, dest) %>%
  filter(month == 1, day == 1, carrier == "WN") %>%
  left_join(airlines , "carrier") %>%
  head(3)
  tibble()
```

A data.frame: 3 × 6

	month	day	carrier	origin	dest	name
	<int>	<int>	<chr>	<chr>	<chr>	<chr>
1	1	1	WN	LGA	BWI	Southwest Airlines Co.
2	1	1	WN	LGA	DEN	Southwest Airlines Co.
3	1	1	WN	EWR	MDW	Southwest Airlines Co.

%lt;0 x 0 matrix%gt;

Find Max, Min, Average and sum distance for each carrier ?

```
flights %>%
    group_by(carrier) %>%
    summarise( max_distance = max(distance),
    min_distance = min(distance),
    mean_distance = mean(distance),
    sum_distance = sum(distance) ) %>%
    arrange(carrier)
    tibble()
```

A tibble: 16 × 5

carrier	max_distance	min_distance	mean_distance	sum_distance
<chr>	<int>	<int>	<dbl>	<int>
9E	1587	94	530.2358	9788152
AA	2586	187	1340.2360	43864584
AS	2402	2402	2402.0000	1715028
B6	2586	173	1068.6215	58384137
DL	2586	94	1236.9012	59507317
EV	1389	80	562.9917	30498951
F9	1620	1620	1620.0000	1109700
FL	762	397	664.8294	2167344
HA	4983	4983	4983.0000	1704186
MQ	1147	184	569.5327	15033955
OO	1008	229	500.8125	16026
UA	4963	116	1529.1149	89705524
US	2153	17	553.4563	11365778
VX	2586	2248	2499.4822	12902327
WN	2133	169	996.2691	12229203
YV	544	96	375.0333	225395

%lt;0 x 0 matrix%gt;

In 2013 Which carrier had most delayed flights from top 100 ?

```
flights %>%
    filter(year == 2013) %>%
    arrange(desc(arr_delay)) %>%
    head(100) %>%
    count(carrier) %>%
    inner_join(airlines, by = "carrier") %>%
    arrange(desc(n))
```

A data.frame: 13 × 3

carrier	n	name
<chr>	<int>	<chr>
DL	36	Delta Air Lines Inc.
AA	17	American Airlines Inc.
EV	14	ExpressJet Airlines Inc.
MQ	9	Envoy Air
FL	6	AirTran Airways Corporation
UA	4	United Air Lines Inc.
B6	3	JetBlue Airways
VX	3	Virgin America
9E	2	Endeavor Air Inc.
US	2	US Airways Inc.
WN	2	Southwest Airlines Co.
F9	1	Frontier Airlines Inc.
HA	1	Hawaiian Airlines Inc.

How many flight each month in 2013 from High to Low ?

```
flights %>%
group_by(month) %>%
summarise(total_flight = n()) %>%
arrange(desc(total_flight)) %>%
head(12)
tibble()
```

A tibble: 12 × 2

month	total_flight
<int>	<int>
7	29425
8	29327
10	28889
3	28834
5	28796
4	28330
6	28243
12	28135
9	27574
11	27268
1	27004
2	24951

```
%lt;0 x 0 matrix%gt;
```

Creat gg plot Relationship between each month and their total air time ?

https://datarockie.com/blog/your-first-ggplot2-visualization/

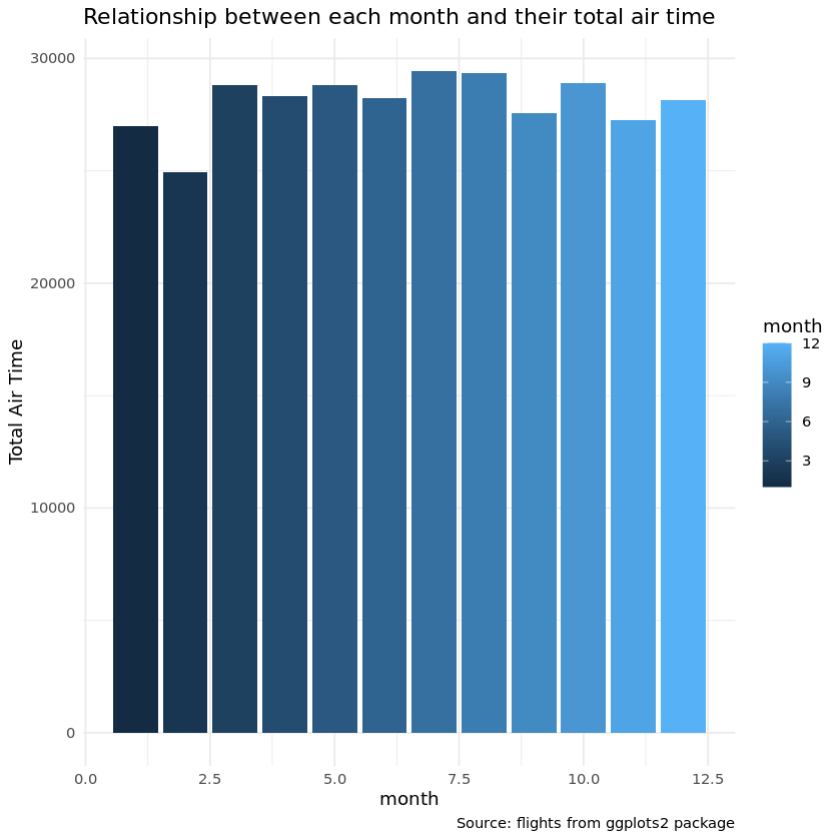
```
joi_plot <- flights %>%
group_by(month) %>%
select(month, air_time) %>%
summarize(air_time = n()) %>%
 arrange(desc(air_time))


joi_plot %>% head(12)
```

A tibble: 12 × 2

month	air_time
<int>	<int>
7	29425
8	29327
10	28889
3	28834
5	28796
4	28330
6	28243
12	28135
9	27574
11	27268
1	27004
2	24951

```
ggplot(joi_plot, aes(fill = month)) +
    geom_col(aes(month,air_time)) +
    theme_minimal()+
  labs(title = "Relationship between each month and their total air time",
       x ="month", y=" Total Air Time",
       caption = "Source: flights from ggplots2 package")
```

Download



How many departure time status on time , delay , cancelled flights in 2013?

```
flights %>%
  select(flight, origin, dest, sched_dep_time, arr_delay) %>%
  mutate(Status_dep = case_when( arr_delay  <= 0   ~  " Flight on time " ,
                                 arr_delay  >= 0   ~  " Flight Delay   " ,
                                TRUE ~ "Flight cancelled")) %>%
  count ( Status_dep) %>%
  rename( Flight_status = n)
  tibble()
```

A data.frame: 3 × 2

Status_dep	Flight_status
<chr>	<int>
Flight Delay	133004
Flight on time	194342
Flight cancelled	9430

```
%lt;0 x 0 matrix%gt;
```

Find carrier that velocity in top 3 ?

v = s / t

s = dest t = air_time

```
flights %>%
    select( carrier ,flight, distance, air_time) %>%
    inner_join(airlines, by = "carrier") %>%
    mutate(velocity = distance/air_time) %>%
    arrange(desc(velocity)) %>%
    head(5)
    tibble()
```

A data.frame: 5 × 6

	carrier	flight	distance	air_time	name	velocity
	<chr>	<int>	<int>	<int>	<chr>	<dbl>
1	DL	1499	762	65	Delta Air Lines Inc.	11.723077
2	EV	4667	1008	93	ExpressJet Airlines Inc.	10.838710
3	EV	4292	594	55	ExpressJet Airlines Inc.	10.800000
4	EV	3805	748	70	ExpressJet Airlines Inc.	10.685714
5	DL	1902	1035	105	Delta Air Lines Inc.	9.857143

```
%lt;0 x 0 matrix%gt;
```

```
flights %>%
    inner_join(planes, "tailnum") %>%
    count(manufacturer)  %>%
    arrange(desc(n))
    tibble ()
```

A data.frame: 35 × 2

manufacturer	n
<chr>	<int>
BOEING	82912
EMBRAER	66068
AIRBUS	47302
AIRBUS INDUSTRIE	40891
BOMBARDIER INC	28272
MCDONNELL DOUGLAS AIRCRAFT CO	8932
MCDONNELL DOUGLAS	3998
CANADAIR	1594
MCDONNELL DOUGLAS CORPORATION	1259
CESSNA	658
GULFSTREAM AEROSPACE	499
CIRRUS DESIGN CORP	291
ROBINSON HELICOPTER CO	286
BARKER JACK L	252
PIPER	162
CANADAIR LTD	103
BELL	65
DEHAVILLAND	63
FRIEDEMANN JON	63
STEWART MACO	55
LAMBERT RICHARD	54
KILDALL GARY	51
BEECH	47
MARZ BARRY	44
AMERICAN AIRCRAFT INC	42
LEBLANC GLENN T	40
AGUSTA SPA	32
SIKORSKY	27
PAIR MIKE E	25
DOUGLAS	22
LEARJET INC	19
AVIAT AIRCRAFT INC	18
HURLEY JAMES LARRY	17
AVIONS MARCEL DASSAULT	4
JOHN G HESS	3

%lt;0 x 0 matrix%gt;